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KNOWLEDGE AND ATTITUDE TOWARDS PHARMACOVIGILANCE AND ADVERSE DRUG REACTION REPORTING AMONG DENTAL MEDICINE STUDENTS IN THE REPUBLIC OF MACEDONIA

ЗНАЕЊАТА И СТАВОВИТЕ НА СТУДЕНТИТЕ ПО ДЕНТАЛНА МЕДИЦИНА ОД РЕПУБЛИКА МАКЕДОНИЈА ЗА ФАРМАКОВИГИЛАНЦАТА И ПРИЈАВУВАЊЕТО НА НЕСАКАНИ РЕАКЦИИ НА ЛЕКОВИ

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Abstract

The aim of this Study is to evaluate the knowledge and attitude towards pharmacovigilance and adverse drug reactions reporting among the dental medicine students in Macedonia. **Material and method.** This study was carried out by using a Survey Questionnaire among the pre-final and final year dental medicine students of Faculty of Dentistry in Skopje, University „Ss Cyril and Methodius“ in Skopje. The questionnaire was adapted from the previously published article of Shivadasan and Sellappan and modified according to the needs of the present study. The Questionnaire was distributed in November 2017. The Questionnaire questions related to the students demographic data, consisting of total of 28 survey items organized into two sections. The data was analyzed by using Statistica 7.1 for Windows and SPSS 17.0. Descriptive statistical analyses such as frequencies and percentages were used. **Results.** The Questionnaire was administered to 93 participants of whom 44 were from pre-final year and 49 were from final year. Out of the 93 participants, about 20.43% of participants answered correctly for the definition of pharmacovigilance. It was found that 32,25% of the participants answered correctly for the question on the important purpose of pharmacovigilance. 26,88% of the participants answered correctly that pharmacovigilance system is established in the Republic of Macedonia. Among the pre-final and final year students, 18,18% and 34,69% respectively answered correctly. About 90,91% of students from pre-final year either strongly agreed or agreed that pharmacovigilance should be taught to all health care students during their curriculum. Only 31,82% and 22,45% of pre-final and final year students respectively either strongly agreed or agreed that with their present knowledge, they are very well prepared to report any ADRs in their future practice. **Conclusion.** In the present study, the attitude of the students were positive, however their knowledge has to be increased in some aspects referring to ADR reporting. Creating awareness and carrying out educational intervention or training among these health care students would help these students to gain knowledge, which is very essential for their future practice. **Key words:** pharmacovigilance, students, knowledge, attitude, adverse drug reaction.

Апстракт

Целта на оваа студија е да се проценат знаењето и ставовите на студентите по дентална медицина од Република Македонија за фармаковигиланцата и несаканите реакции на лековите. **Материјал и метод.** Студијата беше спроведена со користење на анкетен прашалник наменет за студентите по дентална медицина од претпоследна и последна година на студирање на Стоматолошкиот факултет во Скопје при Универзитетот „Св. Кирил и Методиј“ во Скопје. Беше користен прашалник од претходно објавениот труд на Sivadasan и Sellappan, кој беше модифициран според потребите на оваа студија. Прашалникот беше дистрибуиран до студентите во ноември 2017 година. Анкетниот прашалник содржеше прашања за демографските податоци на студентите и вкупно 28 прашања организирани во два дела. Податоците беа анализирани со користење на програмат Statistica 7.1 за Windows и SPSS 17.0. Беа користени дескриптивни статистички анализи, како што се фреквенции и проценти. **Резултати.** Прашалникот беше спроведен кај 93 студенти, од кои 44 беа од претпоследната година, а 49 беа од последната година на студирање. Од 93 учесници, 20,43% од испитаниците правилно одговориле на прашањето за дефинирањето на фармаковигиланцата. Утврдивме дека 32,25% од учесниците правилно одговориле на прашањето за целта на фармаковигиланцата. 26,88% од испитаниците точно одговориле дека во Република Македонија е воспоставен систем за фармаковигиланца. Студентите од претпоследната и последна година, 18,18% и 34,69%, правилно одговориле на ова прашање. Околу 90,91% од студентите од претпоследната година, многу се согласуваат или се согласуваат дека фармаковигиланцата треба да ја изучуваат сите здравствени работници во рамки на наставната програма. Само 31,82% од студентите од претпоследната и 22,45% од последната година, многу се согласуваат или се согласуваат дека со сегашното знаење тие се добро подготвени да ги пријават несаканите реакции на лековите во своја идната практика. **Заклучок.** Во оваа студија, ставовите на студентите се позитивни, но нивното знаење треба да се зголеми во некои аспекти поврзани со пријавувањето на несаканите реакции на лековите. Преку едукативна интервенција или обука и создавањето на свест помеѓу студентите ќе се придонесе за да истите стекнат поголеми знаења, што е многу важно за нивната идна практика. **Клучни зборови:** фармаковигиланца, студенти, знаења, ставови, несакана реакција на лек.

Introduction

Safety and efficacy are the two major concerns regarding a particular drug. The efficacy of a drug can be quantified with relative ease, but the same cannot be said about safety. This is because the adverse effect of a drug may be uncommon (but very serious) and many patients may be affected or exposed to a potential risk before the causality of the drug is established¹⁻². According to Barker, there are three possible actions of drug: the one you want, the one you don't want, and the one you don't know about³.

Adverse drug reaction (ADR) is defined by the World Health Organization (WHO) as "a response to a drug which is noxious and unintended, and which occurs at doses normally used for prophylactic, diagnostic, or therapeutic purposes or for the modification of physiologic function"⁴.

Adverse Drug Reactions (ADRs) are an imperative weakness in public health sector as they represent a substantial fiscal burden on the society and health-care systems. It is one of the significant causes resulting with hospitalization, varying between 5-20%⁵⁻⁷. Furthermore, according to Uppsala Monitoring Centre, which maintains the international database of adverse drug reaction reports, only 6-10% of all the ADRs are reported. Hence, the detection, recording and reporting of adverse drug reactions becomes vital and health experts should be encouraged to execute this appropriately to ensure safer usage of medicines. For this purpose, the concept of pharmacovigilance has been established⁶.

The etymological roots for the word "pharmacovigilance" are: *pharmakon* (Greek word for 'drug') and *vigilare* (Latin word for 'monitoring')⁸. According to WHO, pharmacovigilance is defined as "the science and activities relating to the detection, assessment, understanding and prevention of adverse effects or any other possible drug-related problem, particularly long term and short term adverse effects of medicines."⁹ It has been recommended for every country to set up their own pharmacovigilance programs and in the recent past several countries have initiated pharmacovigilance programs to identify the drugs causing ADRs⁸⁻⁹.

The definition that is accepted in the national legislation is similar to the WHO definition. According to the Law on medicines and medical devices¹⁰, pharmacovigilance is a system applied for the purpose of detecting, gathering, monitoring, assessing and responding to new data on safety of medicinal product and risk-benefit balance related to the use of medicinal product or its interaction with other medicinal products. The pharma-

covigilance system is further regulated with Regulations on the manner of reporting, contents of the reporting form for adverse reactions to medicinal products and the manner of organisation of pharmacovigilance system¹¹. According to this Regulation, adverse reactions to a medicinal product are all unintended reactions to medicinal products which appear during the application of the medicinal product according to the prescribing instructions or in application of any dose of the medicinal product in clinical trials¹¹.

Several studies have been conducted to evaluate the knowledge, attitude and practice towards pharmacovigilance activity among doctors, pharmacists or nurses in various countries¹³⁻¹⁶, wherefrom conclusion was made that the resident doctors and nurses had good knowledge and awareness on ADR reporting. However, there is need for improvement in their practices¹⁴. Many factors, particularly the one related to knowledge and attitudes are responsible for ADR reporting by doctors. These factors have been described as "seven deadly sins" and are related to financial incentives, legal aspects, complacency (serious ADRs well documented by the time of marketing), diffidence (ADR reporting be done if it is certain), indifference (single ADR could not contribute to medical knowledge), ignorance (it is necessary to report only serious or unexpected ADR), and lethargy (lack of time and concern for extra work). Some studies have been carried out to reveal the factors influencing on ADR reporting among medical professionals. These factors have not been investigated especially among dental professionals in Macedonia.

Dental doctors are also involved in prescribing many medicines, including local and systemic anesthetics, antibiotics, analgesic and anti-inflammatory drugs etc.

Antibiotics and analgesics are among the leading causes of ADRs. Hence the risk of ADRs cannot be ignored in dentistry and the contribution of dentists in improving spontaneous reporting cannot be underestimated¹⁷.

In spite of studies conducted among different health care professionals and students, there is a lack of information among dental students and dentists in Republic of Macedonia on knowledge, attitude and practice towards pharmacovigilance and ADR reporting. So there is a need to study the awareness among the dental students and dentists as they are also part of the health care team who are responsible to report ADR during their practice, if any. Hence, this study was designed to examine the knowledge and attitude among pre-final and final year dental students towards pharmacovigilance and ADR reporting.

Material and methods

This study was carried out using a survey questionnaire among the pre-final and final year dental students of Faculty of Dental Medicine in Skopje, within the University „Ss Cyril and Methodius“ in Skopje. The questionnaire was adapted from the previously published article of Shivadasan and Sellappan⁸ and modified according to the need of the present study

The questionnaire was distributed in November 2017, after briefing them on the study objective in their respective classrooms and the participants' informed consent was obtained. The confidentiality of their response was ensured.

The questionnaire included the demographic issues and was consisted of total of 28 survey items organized into two sections. The first section included 14 questions to evaluate the participants' knowledge and the second section included 14 elements to study the attitude and attitude of the participants. The data was analyzed using Statistica 7.1 for Windows and SPSS 17.0. Descriptive statistical analyses such as frequencies and percentages were used.

Results

The questionnaire was administered to 93 participants of whom 44 were from pre-final year and 49 were from final year. 14 (31,82%) of the participants from pre-final year were male, while 30 (68,18%) were female. 17 (34,69%) of participants from final year were male, while 32 (65,31%) were female (table 1).

Table 1. Gender distribution of the participants

	Pre-final year	Final year
Male	14 (31,82%)	17 (34,69%)
Female	30 (68,18%)	32 (65,31%)
Total	44 (100%)	49 (100%)

Knowledge analysis and comparison on knowledge of pre-final and final year dental students

The results for knowledge on pharmacovigilance and ADRs reporting based questions are presented in Table 2. Out of the 93 participants, about 20,43% of participants answered correctly for the definition of pharmacovigilance. About 38,78% of students among

final year students answered correctly and none of the pre-final year students answered correctly. It was found that 32,25% of participants answered correctly the question on the important purpose of pharmacovigilance. Among the pre-final year and final year students, 18,18% and 44,90% respectively answered correctly. For the definition of adverse drug reaction, 75,26% of participants answered correctly. It was found that 63,64% of participants among the pre-final year and 85,71% of participants among the final year answered correctly. Only 13,97% of participants answered correctly on the question on which of the phase in clinical trial, the rare ADRs can be identified. It was found that that none of the participants answered correctly among the pre-final year and 26,53% of participants answered correctly among the final year. Overall 23,65% of participants answered correctly on the question on the location of the international centre for adverse drug reaction monitoring.

It was found that only 7,52% of participants answered correctly on the 'WHO online database' for reporting ADR. Among those who answered correctly, it was observed that none of participants were among pre-final year and 14,29% of participants were among final year students. About 9,67% of the participants answered correctly for the method employed by pharmaceutical companies to monitor ADR of new drugs after launching them into the market. Among the pre-final and final year students, 18,18% and 2,04% respectively answered correctly.

Regarding the most commonly used scales to establish the causality of an ADR, only 3,22% of participants answered correctly and it was found that none of the participants among final year answered this question correctly. However, 4,55% of participants answered correctly among the pre-final year. About 23,65% of the participants answered correctly on the factor causing ADR under-reporting. Among the pre-final and final year students, 22,73% and 24,49% respectively answered correctly.

26,88% of participants answered correctly that in the Republic of Macedonia is established pharmacovigilance system. Among pre-final and final year students, 18,18% and 34,69% respectively answered correctly. It was established that 19,35% of participants answered correctly on the question referring to the regulatory body in Macedonia that is in charge for regulating ADR reporting, it was found that 19,35% of participants answered correctly.

Regarding the next question on what serious event is considered adverse, 39,78% students answered correctly. It was found that 40,91% and 38,78% of participants among the pre-final year and final year respectively

answered correctly. However, 4,3% of the students answered correctly on the question on within how many days a serious adverse event should be reported to the regulatory body in Macedonia. For the last question on

the most important health care professions for reporting ADR, about 32,25% of participants answered correctly, that is 18,18% of participants among the pre-final year and 44,90% of participants among the final year.

Table 2: Knowledge assessment on pharmacovigilance and ADRs reporting among pre-final and final year dental students

Question	Correct response		Overall
	Pre-final year	Final year	
Pharmacovigilance is	0 (0%)	19 (38,78%)	19 (20,43%)
The important purpose of Pharmacovigilance is	8 (18,18%)	22 (44,90%)	30 (32,25%)
Which one of the following best describes the 'Adverse drug reaction'?	28 (63,64%)	42 (85,71%)	70 (75,26%)
Rare ADRs can be identified during which of the following phase of a clinical trial	0 (0%)	13 (26,53%)	13 (13,97%)
The international centre for adverse drug reaction monitoring is located in	6 (13,64%)	16 (32,65%)	22 (23,65%)
Which one of the following is the "WHO online database" for reporting adverse drug reaction?	0 (0%)	7 (14,29%)	7 (7,52%)
Which of the following methods is commonly employed by the pharmaceutical companies to monitor adverse drug reactions of new drugs once they are launched into the market?	8 (18,18%)	1 (2,04%)	9 (9,67%)
Which of the following scales is most commonly used to establish the causality of an ADR?	2 (4,55%)	1 (2,04%)	3 (3,22%)
Which factor will be the cause of ADR under-reporting?	10 (22,73%)	12 (24,49%)	22 (23,65%)
Is a pharmacovigilance system established in the Republic of Macedonia?	8 (18,18%)	17 (34,69%)	25 (26,88%)
Which of the following regulatory body in Republic of Macedonia regulates ADR reporting?	6 (13,64%)	12 (24,49%)	18 (19,35%)
A serious adverse event is	18 (40,91%)	19 (38,78%)	37 (39,78%)
A serious adverse event in Republic of Macedonia should be reported to the Regulatory body within	2 (4,55%)	2 (4,08%)	4 (4,3%)
The most important healthcare professional(s) responsible for reporting ADR is/are	8 (18,18%)	22 (44,90%)	30 (32,25%)

Attitude analysis and comparison of attitude of pre-final and final year dental students

The results on the attitude towards pharmacovigilance and adverse drug reaction reporting among the pre-final and final year dental students are presented in Table 3. 100% of participants among the pre-final year and 97,96% of participants among the final year participants either strongly agreed or agreed that ADR reporting is

necessary. For the attitude towards reporting adverse drug reaction as a professional obligation, 100% and 95,92% of participants among the pre-final and final year either strongly agreed or agreed respectively. The attitude of the respondents is identical regarding the necessity of confirming ADR before its' issuance on the market is identical.

The participants were asked whether they think ADR reporting should be voluntary for which 81,82% of

participants among the pre-final year either strongly agreed or agreed. However, 69,39% of participants among the final year either disagreed or strongly disagreed. Similarly, the participants were asked whether they think ADR reporting should be compulsory for which, 95,45% and 85,72% participants among the pre-final and final year either strongly agreed or agreed respectively.

For the question on whether it is necessary to report only serious and unexpected reactions, 72,73% of participants among the pre-final year either strongly

agreed or agreed. However, 61,22% of participants among the final year either disagreed or strongly disagreed. About 90,91% of students from pre-final year either strongly agreed or agreed that pharmacovigilance should be taught to all health care students during their curriculum. Among final year students, 85,71% had the same perception. About 4,55% of pre-final year and 16,33% of final year participants either strongly agreed or agreed that the topic on pharmacovigilance is well covered in their curriculum.

Table 3: Attitude towards pharmacovigilance and adverse drug reaction reporting among pre-final and final year dental students

Question	Pre-final					Final				
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Do you think adverse drug reaction reporting is necessary?	44 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	32 (65,31%)	16 (32,65%)	0 (0%)	1 (2,04%)	0 (0%)
Do you think reporting adverse drug reaction is a medical staff's professional obligation?	34 (77,27%)	10 (22,73%)	0 (0%)	0 (0%)	0 (0%)	31 (63,27%)	16 (32,65%)	1 (2,04%)	1 (2,04%)	0 (0%)
Do you think it is necessary to confirm ADR of a particular drug before its issuance?	38 (86,36%)	6 (13,64%)	0 (0%)	0 (0%)	0 (0%)	36 (73,47%)	11 (22,45%)	2 (4,08%)	0 (0%)	0 (0%)
Do you think pharmacovigilance reporting should be exclusively on voluntary basis?	14 (31,82%)	22 (50,0%)	0 (0%)	4 (9,09%)	4 (9,09%)	6 (12,24%)	7 (14,29%)	2 (4,08%)	27 (55,10%)	7 (14,29%)
Do you think pharmacovigilance reporting should be compulsory?	20 (45,45%)	22 (50,0%)	0 (0%)	2 (4,55%)	0 (0%)	22 (44,90%)	20 (40,82%)	2 (4,08%)	3 (6,12%)	2 (4,08%)
Do you think that it is necessary to report only serious and unexpected reactions?	4 (9,09%)	28 (63,64%)	0 (0%)	12 (27,27%)	0 (0%)	2 (4,08%)	10 (20,41%)	7 (14,29%)	22 (44,90%)	8 (16,33%)
Pharmacovigilance should be taught to all health care students during their curriculum.	16 (36,36%)	24 (54,55%)	4 (9,09%)	0 (0%)	0 (0%)	18 (36,73%)	24 (48,98%)	1 (2,04%)	4 (8,16%)	2 (4,08%)
I believe that the topic of pharmacovigilance is well covered in my curriculum.	2 (4,55%)	0 (0%)	4 (9,09%)	14 (31,82%)	24 (54,55%)	1 (2,04%)	7 (14,29%)	2 (4,08%)	13 (26,53%)	26 (53,06%)
I do not have any idea on how to report ADRs	16 (36,36%)	26 (59,09%)	0 (0%)	2 (4,55%)	0 (0%)	6 (12,24%)	28 (57,14%)	8 (16,33%)	5 (10,20%)	2 (4,08%)
Information on reporting ADRs should be presented to all health care students in their curriculum.	16 (36,36%)	22 (50,0%)	0 (0%)	6 (13,64%)	0 (0%)	16 (32,65%)	26 (53,06%)	3 (6,12%)	4 (8,16%)	0 (0%)
Information on reporting ADRs shall be better learnt during additional seminars/training/student exchange programs	10 (22,73%)	34 (77,27%)	0 (0%)	0 (0%)	0 (0%)	11 (22,45%)	27 (55,10%)	2 (4,08%)	8 (16,33%)	1 (2,04%)
A pharmacist is one of the most important health care professional to report ADRs.	10 (22,73%)	18 (40,91%)	2 (4,55%)	14 (31,82%)	0 (0%)	7 (14,29%)	17 (34,69%)	5 (10,20%)	16 (32,65%)	4 (8,16%)
In my opinion, reporting of already established ADRs will make no significant contribution to the reporting system.	2 (4,55%)	8 (18,18%)	6 (13,64%)	20 (45,45%)	8 (18,18%)	2 (4,08%)	12 (24,49%)	3 (6,12%)	20 (40,82%)	12 (24,49%)
With my present knowledge, I am very well prepared to report any ADRs notice in my future practice.	10 (22,73%)	4 (9,09%)	2 (4,55%)	22 (50,0%)	6 (13,64%)	2 (4,08%)	9 (18,36%)	3 (6,12%)	25 (51,02%)	10 (20,41%)

The results found that 95,45% of pre-final students either strongly agreed or agreed that do not have idea on how to report ADRs to the relevant authorities in Republic of Macedonia. Among the final year students, about 69% of participants had the same perception. 86,36% of pre-final year participants either agreed or strongly agreed that information on reporting of ADRs should be taught to all health care students during their curriculum, whereas, 85,71% of final year participants had the same perception.

100% of pre-final students have agreed that the information on ADR reporting shall be better learnt during internships, additional seminars, training and student exchange, while, 77,55% of final year students agreed to the same. It was found that 63,64% of pre-final students admitted that pharmacist is one of the most important health care personnel to report ADR whereas, among the final 48,98% of the participants have the same perception. For the students' perception on whether reporting of known ADRs will make any significant contribution to the reporting system, about 22,73% of pre-final students participants and 28,57% of participants from final year agree. Only 31,82% and 22,45% of pre-final and final year students respectively either strongly agreed or agreed that with their present knowledge, they are very well prepared to report any ADRs in their future practice.

Discussion

Adverse drug reactions results in unnecessary health care expenditures through augmented patient morbidity and mortality. Awareness about ADRs among the health care professionals can minimize the factor contributing to adverse drug reaction reporting. Knowledge is a very important factor that influences attitude and practice. Various studies had been carried out in different countries to assess the knowledge of pharmacovigilance among the medical, pharmacy, dental students and practitioners¹⁸⁻²¹.

The present study was conducted among the pre-final and final year dental students and 93 students participated. From the results, it was noticed that the overall knowledge on the definition of pharmacovigilance was poor among these students. Namely, only 10,43% of them were familiar with the definition on pharmacovigilance (table no. 2) On comparison, final year dental students had better knowledge than pre-final year students. However, a low percentage of students knew the purpose of pharmacovigilance.

The definition of adverse drug reaction was known better by the final year students. The student's knowl-

edge was poor for the question on the phase which rare ADRs can be identified, the location of the international centre for ADR monitoring, 'WHO online database' for reporting ADR, the most commonly used scales to establish the causality of an ADR and cause of ADR under-reporting. Our results are similar to the results of other surveys^{8,22-24}.

Final year students were better aware that the regulatory body that regulates reporting in the Republic of is the Macedonian Agency for Drugs and Medical device (MALMED). However, the overall knowledge was poor. The results show that knowledge among students on what a serious event is poor. Unfortunately, only 4,3% of the students were aware on which stage of the process a serious adverse event should be reported to the Macedonian Agency for Drugs and Medical device (MALMED).

Small percent of students were aware that dentists are also important health care professionals to report ADR. This suggests that pharmacovigilance topic is either not incorporated sufficiently or not incorporated in the curriculum and there is need of information regarding the topic among these students. Educational training programs on the topic can enhance their knowledge and perception as recommended by different researchers^{25,26}. Pharmacovigilance modules taught to the undergraduate students must be associated to modules on the rational use of medicines²⁷.

The results of the present study showed that most of the students had positive perception on ADR reporting. Most of the students agreed that ADR reporting is a professional obligation. ADR reporting, as a professional obligation, is subject to moral binding to healthcare professionals and ethical issues. Previous studies have also reported that ADR reporting should be a professional obligation²⁷⁻²⁹.

About 90,91% of students from pre-final year either strongly agreed or agreed that pharmacovigilance should be taught to all health care students during their curriculum. Among final year students, 85,71% had the same perception. This indicated their positive perception for importance of pharmacovigilance. This finding is similar to others studies involving healthcare professionals^{25,30}. Three fourth of the students also agreed that the information on ADR reporting shall be better learnt during additional seminars, trainings and student exchange. One-half of the participants perception was that pharmacist is one of the most important health care personnel to report ADR. These findings are similar to the results of healthcare professionals in other studies^{8,20,31,32}.

Under-reporting of ADRs is a common problem in pharmacovigilance program. The reasons for under-reporting are due to inadequate funds, lack of trained

staff and lack of awareness about the detection, communication and spontaneous monitoring of ADRs. The effectiveness and success of any pharmacovigilance system depends highly on the participation of all health care professionals and thus, dentists are also important healthcare professionals responsible for the pharmacovigilance activities and ADR reporting during their practice¹⁷.

Conclusion

It is essential that ADRs are to be reported and their significance is communicated effectively to the public who is under strong influence of the knowledge and attitude of health care professionals. The lack of knowledge and negative perceptions about pharmacovigilance and ADR reporting would lead to ADR under-reporting. Overall, the final year dental students had better knowledge than pre-final year students. Fortunately, in the present study, the attitude of the students were positive, however their knowledge has to be increased in some of the aspects of ADR reporting. Creating awareness through educational intervention or training among these health care profession students would help these students to gain knowledge, which is very essential for their future practice.

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SPONTANEOUS VERSUS GUIDED BONE REGENERATION OF BONE DEFECTS IN THE JAWS

СПОНТАНА НАСПРОТИ ВОДЕНА КОСКЕНА РЕГЕНЕРАЦИЈА КАЈ КОСКЕНИ ДЕФЕКТИ ВО ВИЛИЦИТЕ

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Abstract

Aim: The goal of this work is to compare the bone density and regeneration of the bone with or without using the GBR technique after cystectomy, using the x-ray examination. **Material and method:** The clinical case includes two male patients, at the age of 30 and 40 with detected radicular cysts in the mandible right and maxillae left quadrant. They are clinically and radiologically observed in a period of 12 months. In both cases we performed completely removing of the cyst lesion (enucleatio in toto) and by protocol the patients received antibiotic therapy in a period from 7-10 days. In one case, the bone substituents were applied – xenograft (Geistlich Bio-Oss® -spongiosa bone granules 0,25-1 mm) and collagen resorptive membrane (Geistlich Bio-Gide® 25x25 m), to cover the augmented bone defect. **Results:** Following the regeneration by using radiological examination after 12 months, we noticed differences in the bone density and presence of mineralized trabecular bone. In the case when we used GBR technique, there was higher bone density and the bone defect was completely filled with new mineralized bone. In the other case, we detected spontaneous bone healing with new trabecular bone, with a presence of smaller number of new trabeculas and radiolucent zone, indicating that the mineralization of the bone was not completed. **Conclusion:** Using the graft materials in large bone defects supports the spontaneous bone regenerative process and enables faster restoration of the anatomic-morphological structure and functionality part of the bone. **Key words:** radicular cyst, cystectomy, GBR, spontaneous bone regeneration

Апстракт

Цел: Целта на овој труд е да се спореди коскениот дензитет и нејзината регенерација со и без користење на GBR техника, по цистектомија и истата да се проследи рентгенографски. **Материјал и метод:** Клиничкиот приказ вклучува двајца пациенти од машки пол, на возраст од 40 и 30 години со радикуларна циста во пределот на мандибуларен десен и максиларен лев квадрант. Случаите се проследени клинички и рентгенолошки во период од 12 месеци. Во двата случаи е направено комплетно отстранување на цистичната лезија (enucleatio in toto) и протоколарно пациентите примиаа антибиотска терапија во времетраење од 7-10 дена. Користени се коскениот супституенти - ксенографт (Geistlich Bio-Oss®) (спонгиозен коскен супституент со гранули 0,25 – 1 mm / 0,5 = 1cc) и колагена ресорптивна мембрана (Geistlich Bio-Gide® 25x25 m). **Резултати:** Радиолошкото проследување на коскениот регенерација по 12 месеци, резултираше со различен коскен дензитет и присуство на минерализирани табекули. Во приказниот случај каде се употреби GBR техника, беше присутен поголем коскен дензитет и коскениот дефект беше целосно исполнет со нова минерализирана коска. Во другиот приказан случај, каде имаме спонтаната коскена регенерација има присуство на помал број нови трабекули и радиолусцентна зона, која наведува дека минерализацијата на коската е некомплетна. **Заклучок:** Употребата на коскениот графтови во големи коскени дефекти, ја поддржува спонтаната коскена регенерација и овозможува побрзо враќање во првобитната состојба на анатоомо-морфолошките структура и функционалноста на коската. **Клучни зборови:** радикуларна циста, цистектомија, GBR, спонтаната коскена регенерација

Introduction

Cysts in the orofacial region are of great clinical importance, according to the high frequency of occurrence and the possibility of their extension that can cause anatomical and pathological disturbances. Kramer¹ in 1974 defines them as pathologic cavity having fluid, semifluid, or gaseous content but not always is lined by

epithelium. WHO classificate them in two types: epithelium and non-epithelium cyst lesions. In the group of epithelium are: developmental (odontogenic and non-odontogenic) and inflammatory cysts.

Inflammatory cyst lesions are developed from the odontogenic epithelium under direct influence of the inflammation and continuous irritation of bacterial nature. Radicular cyst¹ is the most common pathological

lesion among the odontogenic cysts of inflammatory nature, and its origin in cell rests of Malassez which are remnants of Hertwig's root sheath and is a product of the odontogenic epithelial layer. The reason of the appearance is the inflammation of the pulp or necrosis, retained roots, dental trauma and cavity's. They are asymptomatic and slow grow in a direction of a less resistance, where they cause elongation of the buccal cortical plate and possible asymmetry of the alveolar ridge. They have wide age range from 21-59, more often located in the maxilla 60% in the frontal region (Shear, 1992)². Their treatment is surgical which means fully removal of the cyst lesion (enucleatio in toto), or marsupialization. The aim of the treatment is fully anatomic and functional regeneration of the malfunction in the jaw bones.

The bone regeneration is a process depending on the physiological time of the osteogenesis balanced by remodeling. It goes through several phases: inflammatory-proliferative phase (1-14 days), reticular bone tissue (2-6 weeks), callus formation (6-8 months), fully maturation of the bone and remodeling. In the transformation of the non-differential osteogenic cells special role play BMP (Bone Morphogenetic Proteins) and growth factor³.

Postoperative bone regeneration is mostly based on a spontaneous creation of functional vital bone, and depends on various factors like the size defect, the degree of the vascularization, the integrity of the periost and the spongiosa bone, general health condition, age etc. Generally, as a result of a richer vascularization, regeneration in the upper jaw is faster compared to the lower jaw^{9,12}.

In the literature are described various techniques available for regeneration of the deficient alveolar bone. These include: the use of barrier membranes for GBR, particulate grafting materials, onlay block grafting techniques, distraction osteogenesis, ridge split techniques, the future applications of molecular factors to stimulate the rate of bone formation, and in severe defects, a combination staged approach of these techniques⁶.

Guided bone regeneration (GBR) is set as an assuming, effective method for controlling the reparative osteogenesis^{7,8}. The concept for GBR is described for the first time in 1959 and is based on principle of using barrier membranes for space maintenance over a defect. To ensure successful GBR¹⁹, four principles need to be met: exclusion of epithelium and connective tissue, space maintenance, stability of the fibrin clot, and primary wound closure.

GBR procedure is indicating when we have: local alveolar ridge deficiencies (horizontal or limited vertical); osseous fill around immediate implants; dehiscence,

fenestration and bone defects associated with implants; residual bone lesion; aid repair of sinus membrane perforation. In this procedure can be use non-resorbable barriers (ePTFE, titanium reinforced ePTFE, high-density PTFE or titanium mesh membranes) and bioabsorbable barrier membranes (of animal and synthetic origin). In clinical appliance bioabsorbable barrier membrane are preferred⁹.

Bone grafts fall into few categories: autograft, allografts, xenografts, alloplasts and biological mediators of autologous materials. The same are used independently or combined⁷.

Xenografts are biocompatible and osteoconductive, produced from deproteinized bovine bone mineral, but it can sustain coral structure as well. It contains interconnected pore which cause rapid revascularization and are used as precursors of the ossification. Osteoblasts that produce a new bone, after which follows the mineralization so they are deposited on the surface on the granules. In the latest period they are combined with bio substrates-growth factors.

The aim of this study is to reveal the voluminous bone changes and regeneration with or without the application of the GBR technique after enucleation of the medium cyst size formation using orthopantomography. In one of our cases, we used a xenograft and collagen membrane, and in the other, we followed the spontaneous bone regeneration.

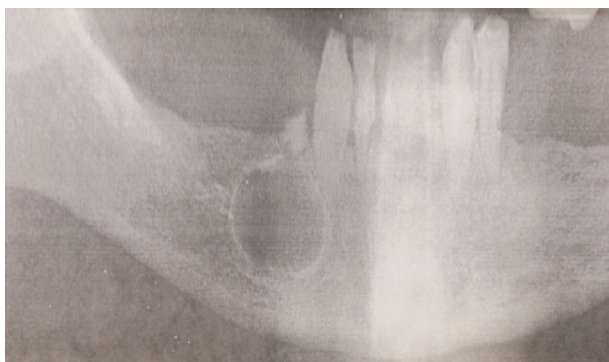
Case presentation

Case no. 1

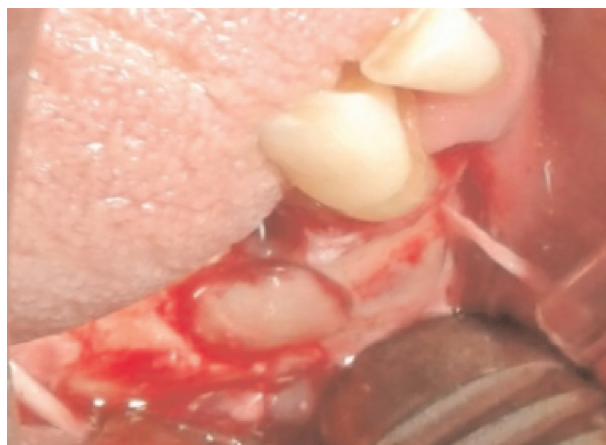
Patient of the age of 47 registered at the Clinic of oral surgery at the Dental clinic Center in Skopje, cause of the presence of a retained root (picture no.1) in the lower



Picture 1. Presence of a retained root in the lower jaw with registered partial and terminal anodontia.



Picture 2. Radiographic examination before the surgery



Picture 4. Present vestibular cortical lamina with dehiscence, and the process of osteotomy.



Picture 3. Crestal with vertical incision



Picture 5. Size of the bone defect before using the GBR technique.



Picture 4. Present vestibular cortical lamina with dehiscence, and the process of osteotomy.

jaw with no subjective symptom. With the clinical examination were registered partial and terminal anodontia and elongation of the alveolar ridge in region 44. After radiographic examination (picture no. 2), Cystis radicularis 44 were diagnosed. The size of the cyst measured on the orthopantomography was 35 x 38 mm.

The surgical intervention was made according to the protocols and the basic surgical principles for treatment of pathological lesion, enucleation of the cyst in general.

After the extraction of the tooth 44, crestal incision was made with vertical incision (picture no.3). Osteotomy started from vestibular cortical lamina with dehiscence (picture no. 4), and after the exposition of the cyst, we completely removed it (enucleatio in toto).

After the cystic enucleation, we applied the Carnoy's solution in the bone defect. The Carnoy's solution consists of 6 ml ethanol, 3 ml chloroform, 1 ml acid acetic and 1 gr of ferric chloride. The advance of using this solution is its ability to demark and fixate the cystic tissue and the haemostatic effect. As for the size of the bone defect (picture no. 5), we recommended GBR technique of the augmentation of the bone to the patient i.e. application of a bone substituent and barrier collagen resorptive membrane.



Picture 6. Comparing the size of the pathological material with dental scalpel.

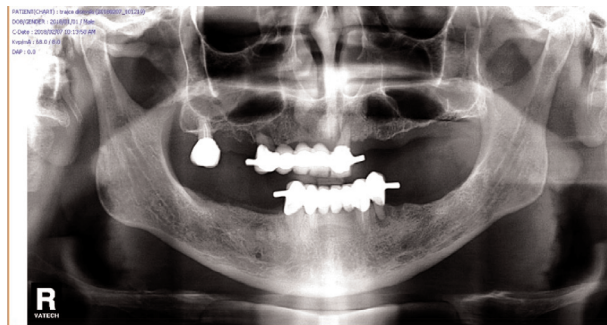


Picture 7. Applying of bone graft materials with barrier membrane (GBR technique).



Picture 8. Post-surgical period (1 day after). No presence of hematoma or edema.

Geistlich Bio-Oss® (natural, non-antigenic, porous bone mineral matrix, granules 0,25-1 mm/0,5=1cc),



Picture 9. Radiology examination after one year of guided bone regeneration.

applied according to Nyman protocol for preparation (picture no.7). The cyst (picture no.6) was sent for pathohistological examination, which confirmed the previous clinical diagnose. Post-surgical period was without the presence of hematoma, edema or neurosensory disorder of the type of repeated paresthesia/anesthesia of n.alveolaris inferior (picture no. 8). In the radiographic examination made after 12 months we could notice that the bone lesion was completely filled with bone (picture no.9)

Case no. 2

Patient of age of 32 registered at the Clinic for oral surgery on the Dental Clinic Center in Skopje, with subjective symptoms (pain). With the anamnesis we obtained elaborated fixed-prosthetic construction on the upper jaw four years ago. During the clinical examination an intraoral fistulae was detected that persisted more than one month, gingival recession on the 22 and 24 with presence of the color change and the inflammation of the gingivae. With palpation an elongation was detected on the alveoli ridge in region of 23, and during the horizontal and vertical percussion of the teeth 22 and 24, was no pain detected. The radiographic examination confirmed the missing of the left canine and the presence of pathological lesion that matched the residual cyst-Cystic residuals with a size of 40 x 40 mm, with pathohistological examination after enucleation.



Picture 1. Radiographic examination before the surgery



Picture 2. Present vestibular cortical lamina with dehiscence



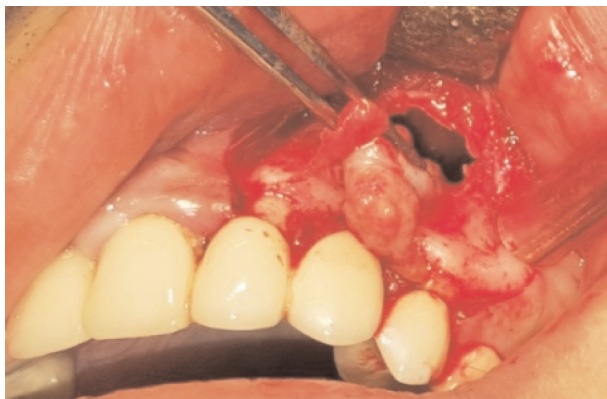
Picture 5. Bone defect size after complete enucleation of the cyst.



Picture 3. Process of osteotomy and exposed cyst lesion, using trapezoidal flap design.



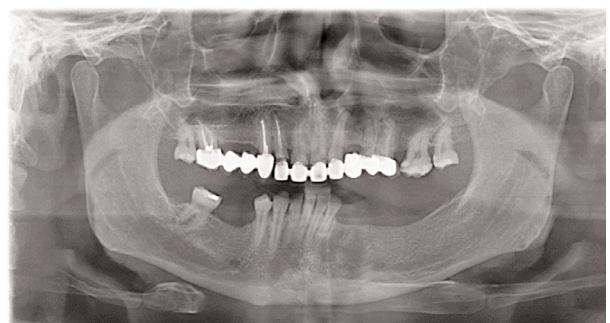
Picture 6. Comparing the size of the pathological material with dental mirror.



Picture 4. Process of complete enucleation of the cyst lesion..



Picture 7. Post-surgical period (1 day after), without presence of hematoma or edema.



Picture 8. Radiology examination after one year of spontaneous bone regeneration..

A trapezoidal flap design was made and osteotomy followed, with enucleatio in toto. Apart from the case no. 1, we didn't use bone substituent and the osseous defect

was recovering according to spontaneous regeneration. After observing the patient for 12 months period, we could see the bone regeneration on the operative field.

Discussion

The therapeutic goal of any extirpative surgical procedure is to remove the entire lesion and leave no cells that could proliferate and cause the recurrence of the lesion¹⁰. The surgical treatment of cysts is discussed without regard to the type of cyst, except for the types that warrant special consideration. Decompression and marsupialization of the cysts¹¹ of the jaw were first suggested by Partsch in the German literature in 1892 and in many parts in the world they are still described as Partsch I and II procedure. Marsupialization (Partsch I) can be used either as the sole therapy for the cyst or as a preliminary step in management, with enucleation deferred until later. On the other hand, enucleation is the treatment of choice for removal of cysts of the jaws and should be used with any cyst of the jaw that can be safely removed without unduly sacrificing adjacent structures. The bone regeneration after cystectomy in normal cases is depending on: the shape, size and location of the cysts, surgical methods, age, and health status of the patients.

Spontaneous and guided bone regeneration is a topic of discussion of many authors. Rubio E. and Mombrú C., present the success of spontaneous bone regeneration after cystectomy. According to them it is preserved from the periost and the morphological elements of the peripheral part of the bone defect. The periost shows a fully osteogenic potential and its cambial layer contains number of non-differential osteogenic cells. At the moment of injury of the bone tissue, these non-differential cells turn into functional osteoblast capable to produce bone (Fawcett, 1986). At the same time, in the peripheral bone defect starts proliferative phase of the blood vessels to end up in the difference of the peripheral fibroblasts in the functional osteoblasts that produce the osteoid matrix that mineralizes later. The 18 patients were divided according to their age, histopathology diagnosis, postoperative control time, and percentage of bone regeneration. 20 patients (66,6%) had 100% bone regeneration after 6 months of cystic enucleation. In the remaining six patients, bone regeneration was approximately with an average of 65,43%. In cases where one of both bone plates (buccal or palatine / lingual) was destroyed by the lesion, bone regeneration was clearly lower. The measurement was made by using Pro-Nemotec program and Nemoceph Densitometric Tool—at the point of intersection (PI) of the lines mentioned

earlier pre-operative and 6 months post-intervention. According to this study, histology of the cyst, the size doesn't have any significant effect on the bone regeneration, until the bone lamina is present even after the cyst enucleation¹².

In a clinical prospective randomized controlled trial by Santamaría no statistically differences have been found between bone regeneration with and without the use of membranes (GBR) after enucleation of inflammatory radicular cysts in 30 patients¹³.

Chiapaschove reported 81,30% reduction of the residual cavity and 91% increase in bone density, at 24 months of control in a study of 27 patients with cysts larger than 40 mm without the use of bone grafting materials¹⁴.

In particular, it has been established that if one or both bone plates (buccal and lingual or palatal) are destroyed by the lesion, the area would not completely fulfill with bone, but it will leave a residual fibrous scar that will manifested by a radiolucency^{13,14}.

In our case that we use GBR technique, we have 100% bone regeneration with good mineralization of the new formed bone. Comparing with the case no.2 where we did not use GBR technique, the final results its slow process of regeneration where we have partial bone regeneration, with good results of it in the distal part of the lesion and with less in the mesial part where we have lack of mineralization and maturation in progress after 12 months of observation. The small osteogenic potential and slow mineralization are the reasons for slow and incomplete bone regeneration that it's going more like reparation than process of regeneration.

After all, the bone tissue has a limited regeneration. In large mandibular defects if no augmentation materials are used, the process of healing takes a long period of time and often ends without full success. Ciapinski D, Niedzielska I, Witowski A. in their study explained the need of filling the defect with materials that have ability to activate all basis mechanism of bone regeneration: osteoconduction, osteoinduction and osteogenesis¹⁵.

The guide of GBR includes: creation of proper chamber, the flow of blood clot, perforation of cortico-spongy part for the increase of vascular, cellular and molecular elements needed for the regeneration process and the use of barrier membrane for the prevention of invasion from tissue that can impede the regeneration. The completed defect covers with the collagen resorbs barrier membrane that enhances the graft retention in the settled position³.

Lalabonova H. and Daskalov H., the aim of their article is to report a case of delayed complication occurring 8 years after the performed cystectomy of the maxilla. They explain the importance of implicated factors that

affect negatively in the reparatory process of osteogenesis, like the presence of devitalized teeth on adjacent closure, the size of the cyst and the adjacent closure of anatomic-morphologic structures (nasal and sinus cavity) which can be possible source of infection in the post-operative cavity. The multiple recurrences of the cysts after their enucleation indicate poor regenerative capacity of the body which resulted in the formation of cicatrice tissue. They recommend the use of GBR in cases of large bone defects that usually occur after enucleation of jaw cysts, even though maxilla has a great potential and capacity for spontaneous regeneration, by which at the end they use the method and results positively¹⁶.

In the examination in the last 15 years the application of biologic mediators are included which accelerate the human bone regeneration^{3,17}. Thus, Pappalardo S. and Guarnieri R. in their study used these principles for enhancing the osteoconductive property of a new highly purified bovine allograft (Laddec[®]) by addition of autologous PRP in regeneration of osseous defects of jaws caused by cystectomy. Radiographic assessments of present study indicated that this association induced a faster new bone growth in the cystic cavities. It was observed that the defect was filled by 56% at the first month, and after a time interval of 6 months postoperatively the defect was filled by 92%, showing a significant increase in vertical height on postoperative successive periapical radiographs¹⁷.

Many studies show the importance and benefits of using biological materials in the development of the tissue i.e. regeneration potential. Autologous plasma as a great growth factor source from different origins (cytokine, morphogen and mitogen) attains the soft tissue and the bone healing when a rapid regeneration is needed, i.e. PRP allows the organism to use the advantage for normal physiological healing for fast injury recovery, so the application is related to effective tissue reparation and regeneration. For many times are showed like proteins that firstly cause proliferation and differentiation from mesenchymal stem cells in osteoblasts, and then proliferation in the human cells which depending on their concentration of PRP increase, that clinically results with increased bone regeneration that later on with a stimulation for a mitogen activity of human trabecular cells leads to healing of bone tissue³.

A combined therapeutic approach consisting of filling the defect with augmentation material, covering it with a barrier membrane and closing the wound is considered by the majority of authors as the best way of treating intraosseous defects in the jaws. In the control group where the bone defect is not treated with bone substituent, later is mainly completed with bone marrow where trabecular bone is detected in a significant small

number vs. comparing to both examination groups in which GBR technique is used. They are less vascularized, that is the other confirmation of slow dynamic of the reparatory process¹⁸.

Conclusion

Bone regeneration is slow process that depends of the time and it takes few months i.e. a year. Spontaneous bone regeneration of bone defects after the enucleation depends on the size of defect, histological type, health state and age of the patient. If we have lack of some of these conditions, the possibility for spontaneous bone regeneration decreases. GBR technique regarding the osseous defects in the jaws is superior and helps for producing more mineral structure, higher density and faster regeneration than spontaneous one. Regarding to this, the pursuits is faster back up of anatomy-morphological structure and functional part of the bone.

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EFFECTS OF SMOKING TO THE LIPID PROFILE IN PATIENTS WITH PERIODONTAL DISEASE

ЕФЕКТИТЕ НА ПУШЕЊЕТО НА ЛИПИДНИОТ СТАТУС КАЈ ПАЦИЕНТИ СО ПАРОДОНТАЛНА БОЛЕСТ

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Abstract

The aim of this study was to determine the effects of smoking towards the lipid status in patients with periodontal disease through analyzing the serum dynamics of lipid parameters (triglycerides, total cholesterol, LDL and HDL cholesterol). The above aim was realized on the Clinic for Periodontology and Oral Medicine on examined group consisting of 45 patients diagnosed with periodontal disease, who were smokers; the control group was consisted of 45 patients diagnosed with periodontal disease, as well, but non-smokers. All the patients were in the age range from 40 to 60 years. According to the number of consumed cigarettes, the patients from the examined group were divided into three sub-groups, each consisting of 15 examinees. The first sub-group was consisted of patients who smoked up to 10 cigarettes in a day (light smokers); the second sub-group was consisted of patients who smoked from 10 to 20 cigarettes in a day (moderate smokers); the third sub-group consisted of patients who smoked more than 20 cigarettes in a day (passionate smokers). The values of Silness-Loe dental plaque index (DPI), index of gingival inflammation (IGI), Cowell gingival bleeding index (GBI) as well as the level of attachment loss (Ramfjord) were noted in both examined and control groups. The results of the total cholesterol and HDL cholesterol showed statistical significant difference between the mean values in the three sub-groups of the examined group, while the mean values of HDL cholesterol in the second and third examined sub-groups and control group are within the reference limits, and the value of the first sub-group is in higher range than the normal one. **Keywords:** TNF- α and IL1- β , periodontal indices, lipid status, smoking.

Апстракт

Целта на овој труд беше да се утврдат ефектите на пушењето на липидниот статус кај пациенти со пародонтална болест преку проследувње на серумската динамика на липидните параметри (триглицериди, вкупен холестерол, ЛДЛ и ХДЛ холестерол). Реализација на поставената цел беше спроведена на Клиниката за болести на устата и пародонтот каде беше формирана испитувана група (45) сочинета од пациенти пушачи со дијагностицирана пародонтална болест и контролна група (45) непушачи со пародонтопатија (класифицирана според ААП од 1999 година) на возраст од 40-60 години. Според бројот на испушени цигари пациентите од испитуваната беа поделени во три подгрупи од 15 испитаници. Првата подгрупа ја сочинуваа пациенти кои пушат до 10 цигари на ден (лесни пушачи). Втората подгрупа ја сочинуваа пациенти кои пушат од 10 до 20 цигари на ден (умерени пушачи). Третата подгрупа ја сочинуваа пациенти кои пушат над 20 цигари на ден (страсни пушачи). Кај двете групи на испитаници беа нотираны индексните вредности на денален плак по Silness-Loe (IDP), гингивална инфламација по Loe Silnes (IGI), гингивално крвавење по Cowell (IGK) како и степенот на губиток на атачмент (Ramfjord). По извршениот клинички преглед и нотирање на индексните вредности кај двете групи на испитаници по пат на венепункција беа земани 5 мл на крв од v subitali. Крвта беше земена во стерилни епрувети и дистрибуирана на Институтот за физиологија при Медицинскиот факултет во Скопје. Анализата на липидниот статус беше направена со колориметриска метода. Анализата на вкупниот холестерол и ХДЛ холестеролот регистрира разлика на просечните вредности кај трите испитувани подгрупи која е статистички сигнификантна, но просечните вредности на ХДЛ холестеролот кај втората и третата подгрупа и контролната група се во граници на референтните, додека просечната вредност на првата подгрупа е повисока од референтната вредност. **Клучни зборови:** TNF- α и IL1- β , пародонтални индекси, липиден статус.

Introduction

The risk of periodontal disease and its prognosis is associated with a number of factors like: age, stress, presence of specific microorganisms, genetics, diabetes and smoking¹. Historically, it was believed that all individuals are uniformly susceptible to development of periodontal

disease and that the accumulation of the dental plaque, bad oral hygiene and possible occlusal trauma are enough to initiate the periodontal disease. During the last four decades it has been accepted that the periodontitis is caused by specific bacterial infection and the individuals are equally susceptible to these infections as from the damage they cause. This understanding made the clini-

cians and researches to focus their efforts on developing markers which will help in identifying the susceptible individuals, prior to the initiation of the disease, as well as the risk factors which can be modified in order to prevent the periodontal disease or to change its course². Smoking is the best confirmed modifying risk factor in the developing and progress of periodontal disease³. Smoking can be involved in the aetiopathogenesis of the periodontal disease through releasing pro-inflammatory cytokines and inflammatory mediators which can be able to initiate cascade of biochemical reactions and to cause periodontal and endothelial damage⁴. Thus, smokers can be systemically affected even in absence of clear clinical symptoms of the disease⁵.

Aim of the study

Taking into consideration the literary data associated to the influence of smoking on the systemic health, as well as to the pathogenic mechanisms of the periodontal disease, the aim of the study was set: to determine the effects of smoking in patients with periodontal disease, through analyzing the serum dynamics of the lipid parameters (triglycerides, total cholesterol, LDL cholesterol and HDL cholesterol)

Materials and methods

In order to achieve the set aim, an examined group consisted of 45 patients - smokers diagnosed with periodontal disease, and a control group consisted of 45 patients - non-smokers with diagnosed periodontal disease were formed at the Clinic for Periodontology and Oral Medicine. All the patients were in the age range 40-60 years. The present periodontal disease was classified according to the American Association of Periodontology from 1999. The diagnosis was established on the basis of anamnesis, clinical evaluation and x-ray findings. Great attention was paid to the anamnesis, in order to gain detailed data for verification of absence of any systemic disease. All the patients signed an informed consent and agreed that the collected data and materials would be used only for scientific and research purposes. According to the number of cigarettes, the patients from the examined group were divided in three sub-groups, each consisting of 15 examinees, as follows:

- first sub-group, consisted of patients who smoked up to 10 cigarettes in a day (light smokers)
- second sub-group, consisted of patients who smoked from 10 to 20 cigarettes in a day (moderate smokers)
- third sub-group, consisted of patients who smoked more than 20 cigarettes in a day (passionate smokers)

The values of Silness-Loe dental plaque index (DPI), gingival inflammation index (IGI), Cowell gingival bleeding index (GBI) as well as the level of attachment loss (Ramfjord) were noted in both examined and control groups. After the clinical evaluation and index values determination, a venepuncture of the cubital vein was performed in all the examinees from both groups and 5 ml of blood were collected from each of them. The blood was collected in sterile test-tubes and transported to the Institute of Physiology in the Medical Faculty in Skopje. The samples were remained still for 2 hours, at room temperature. After the coagulum retraction, the remained serum was centrifuged using Becman centrifuge in 5000 rotations per minute. The analysis of the lipid status was performed using the colorimetric method (Merck diagnostics).

Results and discussion

Smoking and its duration lead to increased concentration of total serum cholesterol, triglycerides, LDL cholesterol, but to lower anti-atherogenic HDL cholesterol⁶, which plays a key role in atherosclerosis process. The combination of nicotine and lipopolysaccharide (LPS) can result in releasing inflammatory cytokines such as IL-1 β and TNF- α , which influence to the lipid metabolism and promote hyperlipidemia⁷. Related to the potential association between smoking, hyperlipidemia and periodontal disease, today it is thought that smoking may induce changes in the immunocellular function, resulting in impaired metabolic regulation of the lipids, through mechanisms which involve proinflammatory cytokines⁸.

A considerable number of cytokines, like IL-1 β and TNF- α are produced as a result of the presence of periodontal pathogenic gram negative bacteria^{9,10}. These cytokines have a great influence on the lipid metabolism¹¹, either through provoking production of other cytokines and changing the chemodynamics (utilization of amino-acids) from different tissues which participate in the lipid metabolism, or through modifying the hypothalamus-hypophysis-adrenal axis and increasing the concentration of adrenocorticotrophic hormones, cortisol, adrenalin, noradrenalin and glucagon in the plasma¹². Therefore, the activity of IL-1 β and TNF- α , microbial exposure and action of nicotine enable the increasing of the level of free fatty acids, cholesterol and triglycerides occur.¹³

The results of this study regarding the total cholesterol show statistically significant differences between the mean values of the groups ($p = 0,018072$) (Table 1), but the mean values are higher within the second and third sub-group in the examined group (Table 2). Post hoc Tukey's test showed predominant difference between the third sub-group and the other sub-groups and the control group (Table 3), which confirms the

Table 1. Mean values of total cholesterol within the examined group with its sub-groups and the control group.

group	Mean value	Number	St. Dev	minimum	maximum
I	5,107143	15	0,523985	4,6	6,7
II	6,080000	15	1,044851	4,9	8,4
III	7,033333	15	2,859987	4,0	13,5
IV	6,270732	45	1,379718	3,5	9,0

This table shows the mean values of total cholesterol which are in normal ranges (3,1-5,5 mmol/l) within the first sub-group, while the mean values in the other two sub-groups and within the control group are higher than the normal values.

Table 2. Analysis of variance of the mean values of total cholesterol

SS	df	MS	SS	df	MS	F	p
27,52450	3	9,174834	209,5115	81	2,586562	3,547116	0,018072

Analysis of variance of the mean values of total cholesterol in the examined group with its sub-groups which are statistically significant for $p=0,018072$.

Table 3. Post hoc Tukey HSD test for total cholesterol

group	I	II	III	IV
I		0,369058	0,009796	0,098171
II	0,369058		0,371497	0,979334
III	0,009796	0,371497		0,400672
IV	0,098171	0,979334	0,400672	

There is statistical significance regarding the total cholesterol mainly between the third sub-group and other groups.

influence of the higher number of smoked cigarettes daily to the systemic and periodontal health. The results regarding to the level of total cholesterol in smokers and non-smokers with periodontal disease are in accordance with the results reported by Katz et al.¹² and Loeshe et al.¹⁴, but opposite to those reported by Kenney et al.¹⁶

Smoking, poor nutrition and high-fat meals result in prolonged impairment of the antibacterial function of the polymorphonuclear leukocytes¹⁶, i.e. hyperreactivity and increased production of oxygen species¹⁷, which is associated with periodontal disease progression in adults.

The concentrations of pro-inflammatory cytokines TNF- α , IL-1 β , prostaglandin E2 (PGE-2) reach high levels in individuals with periodontal disease.¹⁸ Inflamed periodontal tissues may act as a permanent renewable container for releasing of TNF- α , IL-1 β and PGE-2 in circulation, thus evoking extended systemic effects, as well as influencing the lipid metabolism¹⁹. The increase of serum lipids occurs due to the higher synthesis or lower degradation of triglycerides⁹, as well as reduced elimination of LDL cholesterol.

The results regarding to LDL cholesterol show higher values compared to the referent values in the three sub-groups and control group (Table 4). The difference between mean values of the examined groups is not statistically significant for $p=0,090300$ (Table 5). These results about the level of LDL cholesterol in smokers and non-smokers with periodontal disease are in accordance with the results reported by Katz et al.¹² and Loeshe et al.¹⁴, but opposite to those reported by Kenney et al.¹⁶ Nutrition can influence the host inflammatory response, i.e. to participate in the activation of the inflammatory cytokines that affect the immune function and probably have effect on the periodontal health and the condition of some specific systems in the body²⁰. The nutrition with higher intake of saturated fats, but lower intake of cellulose and fruits can lead to changes of the lipid status.

The mean values of HDL cholesterol are within the referent ranges in the second and third sub-group and in the control group, while the mean value in the first sub-group is higher than the referent values (Table 6). The dif-

Table 4. Mean values of LDL cholesterol within the examined group with its sub-groups and within the control group.

group	Mean value	Number	St. Dev	minimum	maximum
I	4,071429	15	1,188036	1,7	5,2
II	4,620000	15	0,829113	2,4	5,7
II	4,900000	15	2,592572	0,7	9,6
IV	3,821951	45	1,343040	1,3	6,1

This table shows the mean values of LDL cholesterol within the examined group with its sub-groups and within control groups which are higher than the referent values (2,2 - 3,5 mmol/l).

Table 5. Analysis of variance of mean values of LDL cholesterol

SS	df	MS	SS	df	MS	F	p
16,08424	3	5,361414	194,2228	81	2,397813	2,235961	0,090300

This table shows the difference between the mean values within the examined groups which is statistically significant for $p=0,090300$.

Table 6. Mean values of HDL cholesterol.

group	Mean value	Number	St. Dev	minimum	maximum
I	3,215385	15	1,302463	1,1	4,9
II	1,446667	15	0,417247	0,5	2,0
II	1,400000	15	0,311677	0,8	1,9
IV	1,368293	45	0,329726	0,7	1,9

This table shows the mean values of HDL cholesterol within the examined groups with its sub-groups and within the control group which are in normal ranges (2,2-3,5 mmol/l) in the second and third sub-group, while the mean values in the first sub-group are higher than the referent values.

Table 7. Analysis of Variance of mean values of HDL cholesterol

SS	df	MS	SS	df	MS	F	p
36,61934	3	12,20645	28,50304	80	0,356288	34,26006	0,000000

This table shows the difference between the mean values of HDL cholesterol in examined groups and control group, which is statistically significant ($p=0,000000$).

ference between the mean values in the examined groups is statistically different for $p=0,000000$. According to post hoc Tukey's test, the difference is mainly significant between the first and other groups (Table 7).

Higher levels of HDL cholesterol show anti-inflammatory action and lower the adhesion of the endothelial cells, with this lowering the risk of cardiovascular diseases. The results regarding to the HDL cholesterol levels in smokers and non smokers with periodontal disease are in accordance with the results reported by Cutler et al.⁶, but opposite to those reported by Buhlin et al.¹⁵

Different mechanisms that lead to lipid alteration due to smoking include the action of nicotine which stimulates the sympathetic adrenal system, which results in higher secretion of catecholamines, higher lipase levels and higher concentration of plasm fatty acids and thus, higher secretion of hepatal fatty acids and triglycerides¹¹. The mean values of triglycerides in the three sub-groups and control group were higher than the referent ones (Table 8). The difference which can be noted between the mean values in the examined groups (smokers) is not statistically significant ($p=0,345041$) (Table 9). The bio-

Table 8. Post hoc Tukey HSD test

group	I	II	III	IV
I		0,000147	0,000147	0,000147
II	0,000147		0,996576	0,972293
II	0,000147	0,996576		0,998116
IV	0,000147	0,972293	0,998116	

This table shows the post hoc Tukey HSD test which shows significance mainly between the first sub-group and other groups.

Table 9. Mean values of triglycerides

group	Mean value	Number	St. Dev	minimum	maximum
I	2,585714	14	0,799863	1,9	4,5
II	2,453333	15	0,604586	1,2	3,2
II	3,106667	15	1,007448	1,6	5,0
IV	2,521951	41	1,393828	0,9	4,7

This table shows the mean values of triglycerides within the examined group with its subgroups and at the control group which are higher than the referent ones (0,1-2,2 mmol/l).

Table 10. Analysis of variance of mean values of triglycerides

SS	df	MS	SS	df	MS	F	p
4,378888	3	1,459629	105,3541	81	1,300667	1,122216	0,345041

This table shows the difference in the mean values of triglycerides between the examined groups and the control group which is statistically significant ($p=0,345041$).

logic signal molecules from the local inflamed tissue has physiologic effects to the stimulation of lipogenesis, increasing the lipolysis and decreasing the lipid clearness, resulting in hyperlipidemia or accumulation of free fatty acids (FFA) and triglycerides²¹.

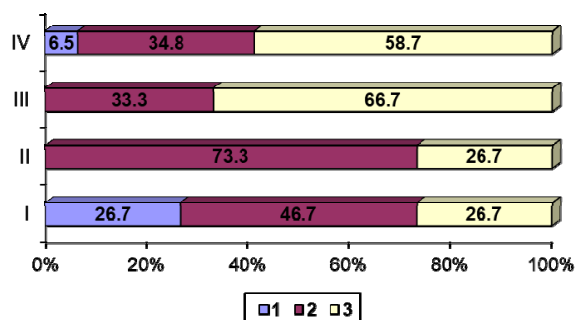
The results regarding to the level of triglycerides in smokers and non-smokers with periodontal disease are in accordance to those reported by Loeshe et al.,¹⁴ but opposite to those reported by Buhlin et al.¹⁵ The analysis of the lipid status in both examined groups showed higher values in both examined groups, thus confirming our results²² on the dependence between the hyperlipidemia and periodontal disease.

The clinical and radiological findings of the periodontal condition indicate that it is worse for smokers compared to non-smokers, while the clinical condition is presented with presence of deep periodontal pockets, higher attachment loss, gingival recession, increased alveolar bone loss and higher values of dental plaque²³. Smoking influences the composition of the subgingival

bacterial flora as well, with that increasing the subgingival infection. Smoking also has effects to the oxidative-reduction potential of the dental biofilm, creating anaerobic conditions and predominance of gram negative anaerobic bacteria²⁴. The decreased protective and reparatory capability of the periodontium and the presence of aggressive bacteria in the dental plaque lead to increased damaging of the periodontium in smokers, compared to non-smokers^{25,26}. The analysis of dental plaque index (DPI) showed percentual difference between the first and second, compared to the third sub-group which is statistically significant ($p=0,0353$); the difference between the first and second sub-group compared to the control group is statistically significant ($p=0,0354$)(Graph 1). The results regarding to the values of the dental plaque index are in accordance with those reported by Machuca et al.,²³ but opposite to those reported by Baab and Qberg²⁷.

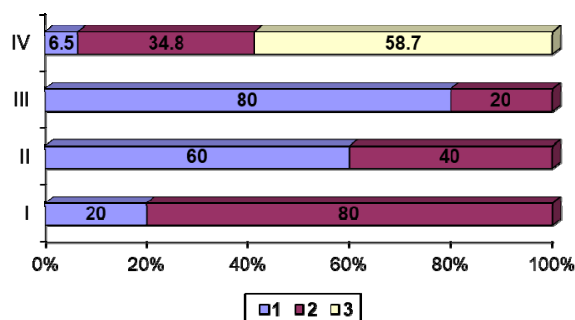
It is our opinion that the higher volume of dental plaque in smokers is a result of bad oral hygiene and for-

Graph 1. Distribution of Silness-Loe dental plaque index



Graph 1 shows the distribution of dental plaque index within the examined group with its sub-groups and control group. There is percentual difference between the first and the second, compared to the third sub-group which is statistically significant ($p=0,0353$) and between the the first and the second sub-group compared to the control group ($p=0,354$).

Graph 2. Distribution of Silness-Loe index of gingival inflammation

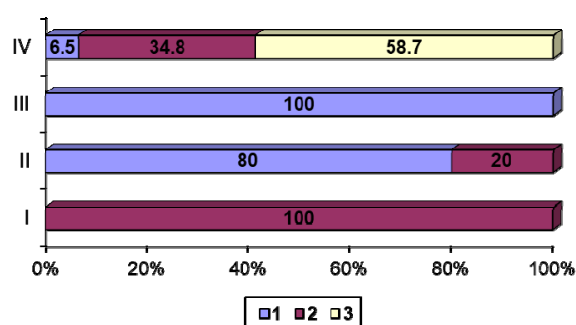


Graph 2 shows the distribution of the index of gingival inflammation within the examined group with its sub-groups and within the control group. A clear percentual difference can be noted between the control group and the second and the third sub-groups which is statistically significant ($p=0,0000$) and between the control group and third sub-group ($p=0,0036$).

mation of nicotine pigmentations which increase the plaque accumulation^{25,26}. The inflammatory response induced by the accumulation of dental plaque may be modified by the secondary products of the tobacco, like the cotinine²⁷, a secondary product of the nicotine which has effect of peripheral vasoconstriction and reduces the clinical signs of gingival inflammation, the redness and swelling²⁸. The reduced intensity of the gingival response is probably due to vascular changes; the thickness of the marginal gingival epithelium is damaged by smoking. The local vasoconstriction effect of the nicotine leads to lower blood flow in the gingival tissue, hypoxia and decreased capability in elimination of the products of the tissue metabolism²⁹. All these events

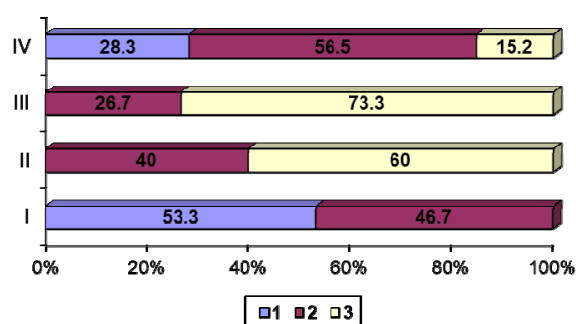
have an effect of decreasing the reparatory capability of the periodontium, which is clinically manifested as delayed tissue healing. The analysis of the index of gingival inflammation (IGI) and gingival bleeding index (GBI) indicates clear percentual difference between the control group and second and third sub-group, which is statistically significant ($p=0,0000$), and between the control group and third sub-group, where a statistically significance is present ($p=0,0036$)(Graph 2). This confirms the peripheral vasoconstriction effect of the nicotine, which reflects with low clinical signs of inflammation in smokers.

Graph 3. Distribution of Cowell index of gingival bleeding



Graph 3 shows the distribution of the Cowell index of gingival bleeding within the examined group with its sub-groups and at the control group. A clear percentual difference can be noted between the control group and the first, second and third sub-groups which is statistically significant ($p=0,0000$).

Graph 4. Distribution of Ramfjord attachment loss index



Graph 4 shows the distribution of Ramfjord attachment loss index within the examined group with its sub-groups and at the control group. Next findings should be noted:

1. attachment loss up to 3 mm. Percentual difference is not statistically significant ($p=0,082$).
2. attachment loss from 3-6 mm. Percentual difference is statistically significant only between the control group and third sub-group ($p=0,0496$).
3. attachment loss higher than 6 mm. Percentual difference is statistically significant between the control group and second and third sub-group ($p=0,00$).

The results regarding to the values of IGI and GBI are in accordance to those reported by Johnson et al.³⁰, but there is no literature data which decline this finding. The effect of smoking to the periodontium is cumulative, t.e. the negative effects depend on the duration of smoking and on the number of smoked cigarettes³¹. The alveolar bone loss and attachment loss in smokers are increased, and the correlation depends on the dose of nicotine taken by smoking and the effect showed years later^{26,31}. The analysis of the attachment loss within the range of 3-6 mm showed percentual difference between the control group and third sub-group which is statistically significant ($p=0,0496$); statistical significance was found between the control, second and third sub-group for the attachment loss higher than 6 mm ($p=0,0496$). The percentual difference was not statistically significant ($p=0,082$)(Graph 4) in the first sub-group and control group for attachment loss up to 3 mm. These results regarding to the index of attachment loss are in accordance with those reported by Rivera-Hidalgo²⁶ and Tanur et al.³¹, but opposite to those reported by Baab and Qberg²⁷.

We consider that nicotine stimulates the osteoclast differentiation, with that increasing the resorption of calcium phosphate, the major structure of bones. Higher concentrations of nicotine lead to increased number of osteoclasts, cells responsible for resorption and remodeling during the periodontal disease.

Conclusions

The investigation of the role of smoking as a risk factor in etiopathogenetic events in periodontal disease, with verification of the lipid status and clinical parameters, led to these conclusions:

1. The parameters of the lipid status detected difference between the mean values in the examined groups which are not statistically significant for LDL cholesterol ($p=0,090300$) and for triglycerides ($p=0,345041$), with mean values higher than the referent ones at the examined sub-groups and at the control group, with exception of the values of triglycerides in the first sub-group which are in normal range.
2. The analysis of total cholesterol and HDL cholesterol showed difference of the mean values for HDL in the three examined sub-groups, which is statistically significant ($p=0,018072$); statistical significance was found between the same groups for the total cholesterol, as well ($p=0,000000$); mean values of HDL in second and third sub-group and control group are in normal ranges,

while the mean value in the first sub-group is higher than the referent values.

3. Results from the analysis of the dental plaque index (DPI) showed percentual difference in the first and second, compared to the third sub-group, which is statistically significant ($p=0,0353$) as well as at the first and second sub-group, compared to the control group ($p=0,0354$).
4. Analysis of the index of gingival inflammation (IGI) indicates clear percentual difference between the control group and second and the third sub-group, which is statistically significant ($p=0,0000$), as well as between the control group and the third sub-group ($p=0,0036$).
5. Analysis of the gingival bleeding index (GBI) indicates clear percentual difference between the control group and first, second and third sub-group, which is statistically significant ($p=0,0000$).
6. Attachment loss at smokers is increased, with the loss level depending on the nicotine dose taken by smoking (number of smoked cigarettes daily) and effect is evident years later.
7. It can be concluded that very serious approach in the treatment of periodontal disease is necessary. It should include frequent check-ups of patients and comprehensive instructions for maintaining oral hygiene in the event of existence of a predisposing factor.

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A LARGE DENTIGEROUS CYST OF THE MANDIBLE – A CASE REPORT

ГОЛЕМА ФОЛИКУЛАРНА ЦИСТА ВО МАНДИБУЛАТА – ПРИКАЗ НА СЛУЧАЈ

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Abstract

Follicular (dentigerous) cysts are odontogenic cysts with developmental origin. Most commonly they develop in the region of the third molars in the mandible and the canines in the maxilla. They are usually detected in adolescents, before the age of 30, on routine x-rays. **Aim:** The aim of this study is to present a rare case of a large follicular cyst with impacted, atopically positioned canine, in a 70 year-old patient. **Material and method:** The patient came to our clinic with a mild edema in the front region of the mandible. The orthopantomograph showed an impacted tooth in the region of the symphysis of the mandible, morphologically appearing as a canine. It also showed a large, well defined lesion with dimensions 46x28mm. A fine needle aspiration biopsy was made, confirming the diagnosis of cystitis/inflamata. We planned the surgical intervention considering the dimension of the cyst and the advanced resorption of the alveolar ridge in that region, so cyst enucleation with preservation of the impacted tooth was performed. The patient was evaluated clinically and radiographically on a 6 month-period of time. After a period of 12 months, when the bone defect after the cyst enucleation was reduced, the erupted canine was extracted with typical extraction. **Key words:** dentigerous cyst, enucleation, impacted tooth.

Апстракт

Фоликуларните (дентигерозни) цисти спаѓаат во групата на развојни одонтогени цисти и најчесто се развиваат околу третите мандибуларни молари и максиларните канини. Се дијагностицираат најчесто случајно, радиографски во адолесцентна и возраст до 30 години. **Цел:** Целта на оваа студија е да се прикаже редок случај на фоликуларна циста на импактиран, атопично позициониран канин кај 70 годишен пациент. **Материјал и метод:** Пациентот се јави на нашата клиника поради благ оток и nelaгодност во предел на фронталната мандибула. На ортопантомографската снимка забележавме импактиран заб во пределот на симфизата со морфолошки карактеристики на канин и голема, јасно ограничена лезија со димензии 46x28mm. Во дијагностички цели, направивме аспирациона биопсија со која се потврди дијагнозата на инфламирана циста. Хируршката интервенција ја планиравме според димензијата на цистата и напредната ресорпција на алвеоларниот гребен во таа регија, по што беше изведена енуклеација на истата со презервација на импактираниот заб. Радиографски и клинички, пациентот беше следен на периоди на 6 месеци. По 12 месеци, кога димензиите на коскениот дефект по енуклеација на цистата беше значително намален, еруптираниот канин беше екстрахиран како типична екстракција. **Клучни зборови:** фоликуларна циста, енуклеација, импактиран заб.

Introduction

The term `cyst` is defined by Kramer in 1974 as `a pathological cavity, having fluid, hemi-fluids or gaseous contents, and which is not created by the accumulation of pus`. Histologically, the cysts in the oral and maxillofacial region are consisted of fibrous capsule, which is lined with epithelium on the inside walls. Some cysts do not have an epithelium lining and the term `pseudo-cysts` is reserved for them.

The classification of the cysts in the oral and maxillofacial region is not an easy task, due to the big variety of cysts that seem similar to one another, but are in fact very different. First classification of odontogenic tumors, jaw cysts, and associated lesions has been created using WHO classification from 1971, as a result of research conducted by international group of oral and other pathologists. Final classification, along with new knowledge, comments, and suggestions regarding previous classification, was made and published in the second edition of the same work, in 1992.

According to this classification, follicular cysts (a.k.a. dentigerous cysts) are in fact odontogenic cysts, and they belong in the group of cysts with developmental origin. Dentigerous cyst is the most common odontogenic development cyst. It can involve any included tooth, although molars and canines are the most affected ones. Cystic formation involving the crown of premolars and incisors is rare³. The frequency with which dentigerous cysts develop has been calculated at 1,44 in every 100 unerupted teeth, more frequent in men than in women⁴.

The dentigerous cyst, by definition, is attached to the cervix of an impacted tooth. Were the tooth to erupt, the dentigerous cyst would burst and cease to be a pathologic entity, as is usually the case in small eruption cysts. Small cysts are also easy to treat surgically. However, dentigerous cysts occasionally become extensive since lesions are asymptomatic even when reaching considerable size and then treatment is more difficult, as associated teeth are often impacted and displaced a considerable distance due to cyst pressure⁵.

These cysts are usually discovered on routine radiographic examination, characterized by a symmetric, well-defined, usually unilocular radiolucent lesion surrounding the crown of an unerupted tooth. Generally there is a distinct, dense periphery of reactive bone (condensing osteitis) with a radiolucent center. These cysts can also manifest as multilocular entities and occasionally may be associated with resorption of the roots of adjacent erupted teeth⁶. They are rarely painful and any pain suffered is associated with infection in the lesion⁴. In some instances, these cysts can grow very large in size and can trigger the inflammation, expansion and erosion of the cortical bone⁴, which is the reason for the difficulties in the treatment of these cysts.

The differential diagnosis of dentigerous cysts include odontogenic fibroma and odontogenic myxoma. Some specimens may contain a focus of unicystic ameloblastoma and therefore require consideration of more extensive treatment⁷.

Aim of the study

The aim of this study is to present a rare case of a large follicular cyst on an impacted, atopically positioned canine in a 70 year-old patient and the modality of the treatment that was used.

Materials and method

A 70 year-old man came to our Clinic complaining about a 'bump' in his lower jaw. The patient had been noticing a discomfort and a strange feeling for some

time, and claimed that it used to be painless. However, the last two months it started to be painful in that area. At this point he turned for help at his general dentist, who sent him at the Clinic of Oral Surgery at the University Clinical Center "St. Pantelejmon" for further examination.

The intraoral examination showed an edema in the vestibular region of the alveolar ridge of the right side of the mandible, in the region of 42-43, with signs of local inflammation. The patient had partial anodontia, with only residual teeth 34, 35 and 44 persisting in the mandible. Palpation of the lesion showed signs of fluctuation and it was painful for the patient. A panoramic radiograph was made (Figure 1.) and it showed a well defined, oval radiolucent lesion, clearly separated of the surrounding bone with a zone of condensed bone – a characteristic of an odontogenic cyst. The dimensions of the cyst was approximately 46x28 mm. An impacted canine could be seen positioned vertically in the middle of the mandible.

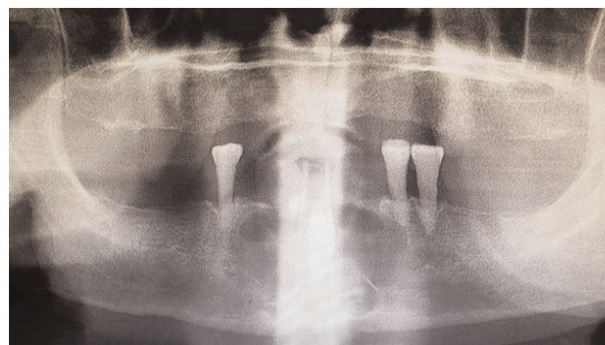


Figure 1. Preoperative panoramic radiograph

In the diagnostic process, as well as the treatment plan of the jaw cysts, the clinical examination of the patient and the x-ray of the lesion are not enough. In this case, regarding the age of the patient and in order to make a differential diagnosis with other pathologic lesions, a fine needle aspiration biopsy was made. The radiographic findings are not a final diagnostic for dentigerous cysts because odontogenic keratocysts, unilocular ameloblastomas, and many other odontogenic and non-odontogenic tumours have radiographic features essentially identical to those of a dentigerous cyst⁸. Ultimately, the definitive type of the cyst can only be proven histopathologically. In every case, postoperative histopathological verification of the removed cyst is obligatory⁸.

Operative technique – The dimensions of the cyst, its association with an impacted tooth, as well as the age of the patient are dictating the modality of the treatment.

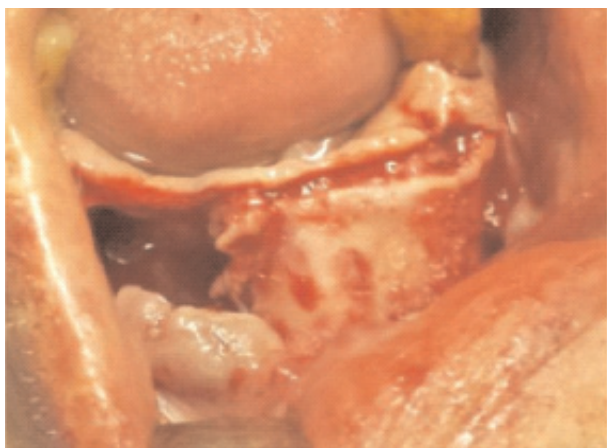


Figure 2. Incision made along the alveolar ridge of the mandible, with two divergent relaxation incisions (reg. 44, 34) towards the base of the alveolar ridge

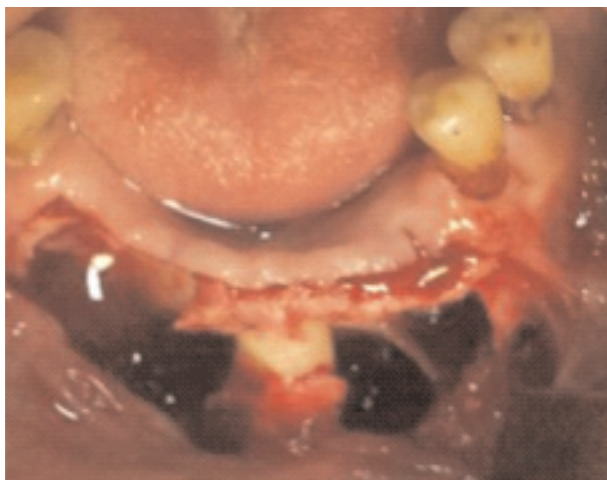


Figure 3. The impacted canine, positioned vertically

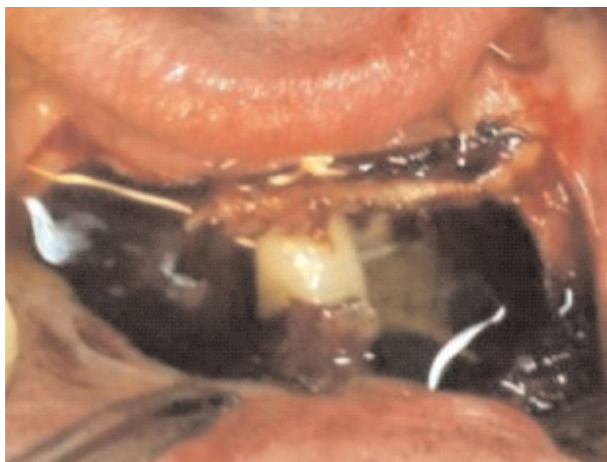


Figure 4. Carnoy's solution is applied

The patient was scheduled for removal of the cystic lesion, with preservation of the impacted tooth.

Bilateral mandibular local anesthesia was applied (Scandonest, Septodont, France), and disinfection of the oral mucosa, lips and surrounding skin was made.

We performed the classic flap design, with incision on the alveolar ridge between the premolars of the mandible, and two divergent vertical relaxation incisions (reg. 44, 34) (Figure 2.). After the elevation of the flap, a dehiscence of the right vestibular cortical lamina was noticed. The impacted tooth (a canine – according to its anatomic-morphological characteristics) was positioned vertically, right in the middle of the mandible, where the lower central incisors should be (Figure 3.).

After the osteotomy and the cystic enucleation, we applied the Carnoy's solution in the bone defect. (Figure 4.).

Consequently to the great size of the cyst there was a great bone loss. However, the apical third of the impacted tooth was surrounded with bone from the vestibular and lingual lamina walls, so we decided to leave the impacted canine in the mandible to serve as an anchor. The impacted tooth is to be removed in second stage surgery, after the decreasing of the bone defect, which was divided into two separate parts, with a medial anchorage from the canine.

Due to the great defect in the oral mucosa, the wound was sutured in a way similar to the suturing technique in marsupialization – the edges of the incision were sutured in the defect of the cyst. The removed cystic lesion was sent for histopathological verification.

The patient was given instruction for the postoperative care and antibiotics were prescribed for seven days. Control check-up was scheduled for the next day. The sutures were removed ten days later. After the removal of the sutures, we detected a mild paresthesia on the right



Figure 5. The situation four months after the intervention



Picture 6. The situation 12 months after the intervention

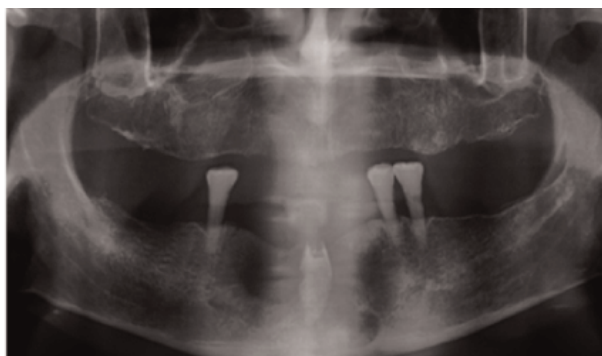


Figure 7. A control panoramic radiograph, 12 months after the intervention



Figure 8. The sutures after the extraction of the canine

side of the chin, as a result of a trauma to the mental nerve, in addition to the large postoperative bone defect.

Four months after the intervention the epithelium completely covered the formerly exposed bone. By this

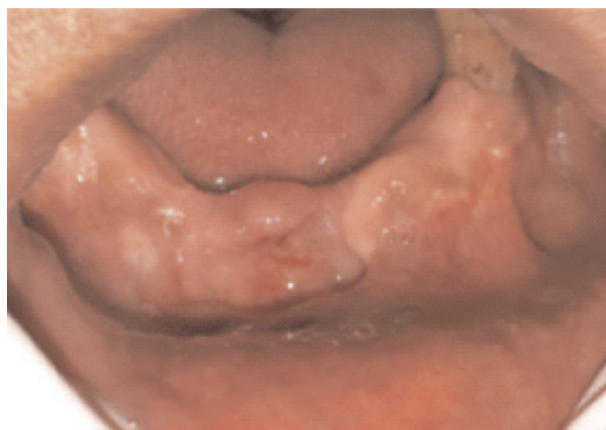


Figure 9. The situation after the removal of the sutures

time, the paresthesia had completely stopped (Figure 5.). A control radiograph was made, showing a reduction of the size of the bone defect.

The intraoral examination 12 months after the intervention showed full consolidation of the mucosa. The formerly impacted canine was visible in the oral cavity (Figure 6.) and a control X-ray was made (Figure 7.). The radiograph showed reduce size of the bone defect, completely filled with newly-formed bone. The formerly impacted canine was erupted, so a typical extraction was performed. The wound was filled with Gelatamp COLTENE® (Figure 8.). The situation after the removal of the sutures is shown in Figure 9.

Discussion

The treatment of the cysts is an object of interest ever since the first description of them appeared, early in the XVII century⁹. The treatment options include enucleation of the cyst and extraction of the tooth or teeth embedded in (or impacted by) the cyst; or decompression and marsupialization without removal of the associated tooth. The principle of marsupialization (the Partsch I method) implies making a fenestration on the wall of the cyst, through which the cystic content drains into the oral cavity. This way, the pressure of the cyst is reduced, resulting in a reduction of the cystic cavity. With the procedure of enucleation (the Partsch II method), the cystic capsule is completely removed from the bone and the possibility of recurrence of the cyst is reduced. This method has found application in small, average and big cysts, when injury of the bordering tissues is excluded and the cyst is surrounded by bone tissue on every side^{10,11}.

The appropriate mode of treatment must take into account several clinical criteria. Recently defined criteria

for selecting the treatment modality (both indications and contraindications) refer to cyst size and site, patient age, the dentition involved and the involvement of vital structures¹². The strategic significance of the associated impacted tooth should also be considered prior to surgery (the impacted canine was atopically positioned, and had no strategic significance for a future prosthetic). In this case a combination of the two methods for treatment of the cysts - Partsch I and II, was made. The cyst was enucleated in toto, that refers to the Partsch II method. However, due to the great size of the defect, the edges of the incision were sutured in the defect of the cyst, quite similar to the Partsch I method.

Follicular cysts are asymptomatic and are usually detected on routine x-rays. They are rarely painful and any pain suffered is associated with infection⁴. Sometimes the cyst is removed intact, but more often the thin wall is ruptured during the surgical procedure. In an inflamed dentigerous cyst the wall may be thickened¹.

Carnoy's solution is a method of chemical curettage for the definitive treatment of odontogenic cysts. This solution consisted of 6ml ethanol, 3ml choloform, 1ml acetic acid and 1gr of ferric chloride. The solution has the ability to demark and fixate the cystic tissue. It also has a haemostatic effect, so it's primarily used to ensure that recurrence of the cyst does not appear⁹.

There is evidence that vital cyst tissue releases a potent bone-resorbing factor, thus causing great bone resorption, which can lead to a pathological fracture¹. Although such fractures may occur in any bone, their most common location in the orofacial skeleton is the mandible¹³. The region of the front mandible is the least likely place for a pathological fracture to occur. In this case however, due to the physiological atrophy of the alveolar ridge, as well as the size of the defect in the bone caused by the cyst and the size of the canine, it was quite possible. The canine was stable due to the quantity of bone surrounding his crown and apex, even though the vestibular lamina was destroyed by the cyst growth. That is the reason that we decided to extract the canine in the second stage, after the removal of the cyst.

Bone healing is a physiologic cascade of events in which complex regenerative processes restore original skeletal structure and function⁷. This is a slow process that can take up several months and bone remodeling last for many years. In this case, performing an augmentation of the alveolar ridge with the use of bone substitute is disputable. The use of bone graft material would make a scaffold as a base for the bone regeneration and ossification process, using osseointegrating characteristic of the bone substitute. After cystectomy, however, we can never be certain that microscopic amounts of cyst epithelium are still present in the bone defect.

Per secundam healing is prolonged and painful, so the patient was advised to take analgesics. To prevent a secondary infection, as well as to ensure a proper oral hygiene and to avoid food to be trapped in the defect of the wound, we suggested an obturator to be made. The patient, however, refused, due to his own reasons.

Conclusion

The treatment of large cysts can be quite difficult, even the established surgical treatment options are available but there are also a great variety of criteria that should be taken into consideration before choosing the treatment method. According to the patient's age, size of the cyst, location, the involvement of vital structures, we consider that this treatment was successful, with minimal surgical trauma for the patient. Periodical evaluation of the patient is to be continued.

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DENTAL CERAMIC MATERIALS, PART I: TECHNOLOGICAL DEVELOPMENT OF ALL-CERAMIC DENTAL MATERIALS

ДЕНТАЛНИ КЕРАМИЧКИ МАТЕРИЈАЛИ, ДЕЛ I: ТЕХНОЛОШКИ РАЗВОЈ НА ЦЕЛОСНО КЕРАМИЧКИТЕ МАТЕРИЈАЛИ

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Abstract

All-ceramic fixed restorations, because of their excellent aesthetic characteristics, are made more and more often. On the other hand, the discontinuity of the dental arches in the posterior regions could be solved by the restorations/bridges made out of the stabilized zirconium dioxide because of its great strength. This article reviews the current literature covering all-ceramic materials and systems. A history regarding the development of these materials is presented, starting with the first all-porcelain "jacket" crown, all the way to recently introduced all-zirconia and resin-matrix ceramic materials. The machinable materials fabricated for the CAD/CAM technology are also presented. **Keywords:** dental ceramics, CAD/CAM, glass ceramic, zirconia, hybrid ceramic.

Апстракт

Фиксните реставрации се почесто се изработуваат целосно од керамички материјали поради нивните извонредни естетски карактеристики. Од друга страна пак, јачината на циркониум диоксидот овозможува протетичко реставрирање на дисконтинуитетот во забните низи и во постериорните регији. Овој ревијален труд ги сублимира податоците од литературата кои се однесуваат на целосно керамичките материјали и системи. Во првиот дел е презентирани технолошкиот развој на овие материјали, почнувајќи од т.н. џекет коронка, па сè до најновите материјали, кога реставрациите целосно се изработуваат од стабилизирани циркониум диоксид или пак од керамиките со смолиста матрица. Посебен осврт е направен на материјалите за машинска - CAD/CAM обработка. **Клучни зборови:** денална керамика, CAD/CAM, стакло керамики, циркониум диоксид, хибридни керамики.

Introduction

Contemporary fixed prosthodontics is based on using all-ceramic restorations. Impeccable esthetics and functionality offered by ceramic materials have put porcelain-fused-to-metal (PFM) system in the background¹.

For a long time the disadvantage of ceramic materials was their insufficient strength. For fabrication of crowns and bridge structures especially in the posterior region where a great masticatory load is generated (and thus possibility of breakage of the substructure), PFM systems had priority when selecting. Today, due to the qualitative development of ceramic materials, in such

clinical cases, restorations can completely be ceramic made².

Contemporary ceramic materials "cover" all indications for fixed prosthetic rehabilitation: single tooth restorations such as veneers, inlays, onlays, crowns and posts, as well as multi-unit bridges. Zirconium posts have priority over those made of metal alloys, because all-ceramic crowns could be made with desirable esthetic effect afterwards³. The fabrication of veneers and crowns in the frontal region should primarily meet the priorities of esthetic and phonetic aspects; inlays, onlays and crowns in premolar and molar region should meet the requirements in terms of strength, esthetics and dura-

bility; multi-unit bridges made of ceramic material should be characterized by high strength and fracture toughness, uniform distribution of masticatory load as well as esthetics². Ceramic material that is used for the fabrication of crowns over the implants should possess ability to absorb masticatory forces and to distribute pressure throughout the whole structure of the crown, to be resilient and reduce stress to the implant⁴. Technological developments in the dental industry in the field of ceramic materials provide prosthetic solution in all of the above mentioned cases.

According to Zarone et al.⁵ “Since the early introduction of the porcelain jacket single crowns into the dental practice, dental ceramics have been considered among the most promising restorative materials because of noticeable prosthetic advantages: esthetic appearance, chromatic stability, biocompatibility, low plaque retention and fluids absorption, high hardness, wear resistance, low thermal conductivity, and chemical inertness”. An ideal all-ceramic material should possess excellent esthetic characteristics, including translucency, light transmission, and natural tooth color, and, at the same time, optimal mechanical properties such as high flexural strength and fracture toughness, as well as limitation of crack propagation that may occur in terms of the functional and parafunctional load conditions; all these features are important for the longevity and reliability of all-ceramic restorations⁵.

However, despite the large number of all-ceramic materials for clinical use, the analysis of Conrad et al.⁶ showed that there is still no universal material or system that could be used in each clinical situation. The successful use of various ceramic systems depends entirely on the clinician’s ability to propose an appropriate treatment plan for each patient individually, to select an appropriate ceramic material and manufacturing technique and to choose appropriate luting material and procedure⁶. But, whether ceramic restoration will meet the expectations of the patient and the dentist depends on the dental technician’s knowledge, skill, creativity and dedication⁷.

This paper reviews the current literature covering all-ceramic materials and systems, with a overview of the technological qualitative development of these materials, starting with the first all-porcelain “jacket” crown, all the way to recently introduced all-zirconia and resin-matrix ceramic materials.

Technological development of dental ceramics

The usage of ceramic materials in dentistry dates back as far as 1889 when Charles H. Land patented the

first all-porcelain “jacket” crown – PJC⁸. It was so-called, as this restoration rebuilds the missing tooth structures with porcelain covering as a jacket. This kind of restoration was extensively used (until the 1950s) after improvements made by E.B. Spaulding⁹.

The failure rate of the “jacket” crowns, which was very high because of the internal micro-cracks that appeared during the cooling phase of fabrication, resulted in the development of the porcelain-fused-to-metal (PFM) system innovated by Abraham Weinstein in the late 1950s¹⁰. Despite the good reliability that this system has, the appearance of PFM restorations doesn’t fulfill the patients’ high esthetic demands.

First successful attempt to strengthen the feldspathic porcelain was made by W. Mc Lean and T.H. Hughes in 1965. They reinforced dental feldspathic porcelain with an addition of up to 50% aluminium oxide powder during the manufacturing¹¹. Although it had twice the strength of the traditional PJC, it could’ve been used in the anterior region only (due to its lower strength). Its higher opacity was also a major drawback¹².

Another development in the 1950s by Corning Glass Works led to the creation of the castable Dacor® crown system in which the glass was strengthened with various forms of mica. A glass restoration (using the lost-wax casting technique) underwent through the “ceramming” process that provided a controlled crystallization of the glass. Such glass ceramics, had different crystalline formations depended on the feldspathic formulation used, such as leucite, fluoromica glass, lithium disilicate, and apatite¹³. Numerous small crystals that were evenly distributed into the glassy matrix increased the strength and toughness of the ceramic. The processing difficulties (time and temperature controlling) and high incidence of fracture were factors that led to the abandonment of this system¹⁴.

The idea for the first pressable ceramic was primarily developed at the University of Zürich, Zürich, Switzerland, in 1983. Later on (1986), Ivoclar Vivadent took over the development project and after some improvements that have been made, in 1990 the IPS Empress system was introduced¹⁵. IPS Empress® 1 was high leucite-containing ceramic in which the leucite crystals, incorporated in the material, increased the coefficient of thermal expansion. The leucite crystals improved flexural strength and fracture resistance through so-called dispersion strengthening, slowing down the micro-crack propagation that easily could happen into the feldspathic porcelain. This process of pressing the heated ceramic ingots became very popular due to the good esthetics and easy usage in the laboratory.

Later on, Ivoclar Vivadent introduced the second generation of heat-pressed dental ceramic material, IPS

Empress® 2, containing about 65 vol % lithium disilicate, which strength was more than twice than that of first generation – the leucite-reinforced IPS Empress® 1. In late '90s, IPS Empress 2 contained 70 vol% lithium disilicate that made material suitable for production not only a single unit restorations but for the 3 unit FPD in the frontal region as well. A 5-year clinical study revealed a 70% success rate when used as a fixed partial denture framework¹⁶.

Since 2004, Ivoclar Vivadent's leucite-based and lithium disilicate ceramic materials for heat-pressed technique are fabricated as IPS Empress Esthetic and IPS e.max Press respectively.

In 1983, Matts Andersson in cooperation with Nobel Biocare developed the Procera method for high-precision industrial manufacturing of dental crowns. In 1989, the first ceramic computer-aided designed and computer-aided manufactured (CAD/CAM) coping, the Procera® AllCeram, was introduced. The Procera® AllCeram crown consisted of a densely sintered alumina core that contained more than 99.9% aluminum oxide to which feldspathic porcelain was fired as a veneering material¹⁷.

When VITA In-Ceram was introduced to the dental market in 1989, a new era of all-ceramic restorations has begun. The slip-casting technique developed by Sadoun allowed the production of restorations with an excellent long-term prognosis including a three-unit anterior bridge without metal substructure¹⁸. The aluminum oxide content of In-Ceram® Alumina has been increased to 80% and, by using the infiltration technique with special lanthanum glass (12% La₂O₃, 4.5% SiO₂), a flexural strength value of approximately 500 MPa was reached for the first time. By using industrially sintered, highly homogeneous aluminum oxide blocks for the CELAY system in 1993 and for the CEREC system in 1997, In-Ceram® Alumina BLANKS gained increased strength and excellent machine processability. In 1994, VITA introduced In-Ceram® Spinel (MgAl₂O₄) with better translucency and esthetics, but lower flexural strength of 250–400 MPa. In-Ceram® Zirconia is considered as a modification of In-Ceram® Alumina, in which, for the first time, zirconium oxide was used as in a dental ceramic. Alumina core was strengthened with 33 wt.% of 12 mol% cerium-partially stabilized zirconium oxide, which increased the flexural strength to 620–700 MPa¹⁹. Until then, many problems regarding stability of zirconia used as biomedical material have been already solved.

Since 1969, zirconia has been considered as a material for production of surgical implants²⁰. In 1985, yttria-stabilized zirconia was used for the first time to replace femoral heads in the hip joint arthroplasty²¹. Between 2000 and 2002, a series of premature failures

(fractures) of ceramic heads made of Y-TZP in such prostheses were reported^{22,23}, that resulted in reduced use of zirconia in orthopedic surgery by more than 90%²⁴. The reason for such fractures was changed processing procedure during the production, which resulted in increased monoclinic content^{23,25}. These episodes increased awareness of phase transformation of a zirconia used as bio-material and imposed caution during processing of the material and production of prosthesis.

In 2001, the Cercon all-ceramic CAM system was introduced, using for the first time dental zirconia for the production of crowns and bridges. Two years later, colored Cercon bases were introduced, offering not only a material with high flexural strength but a material with natural, tooth-like shades that meets aesthetic demands²⁶.

In the last 20 years, most of the ceramic manufacturers have started a production of an already established and proven all-ceramic materials, as milling blocks for a CAD/CAM fabrication, but with improved chemical composition and mechanical features. The first commercially available all-ceramic CAD/CAM material was VITABLOCS Mark I (1985), feldspar ceramic that in 1991 was replaced by Mark II. Ivoclar Vivadent's leucite-reinforced and lithium disilicate ceramics (known as IPS Empress Esthetic and IPS e.max Press for heat-press technique) were introduced (2006) as IPS Empress CAD and IPS e.max CAD respectively. As a replacement for the glass infiltrated Vita In-Ceram® Alumina and Vita In-Ceram® Zirconia, VITAZahnfabrik offered densely sintered alumina and zirconia CAD/CAM blocks -In-Ceram® Al and In-Ceram® YZ.

The use of CAD/CAM technology spurred a whole new generation of zirconium dioxide-based materials used for manufacturing of substructures with superior mechanical properties. They are characterized with sufficient flexural strength of 900 MPa to 1300 MPa, allowing to be used for fabrication of multi-unit posterior bridges. Final esthetic appearance of the restorations is achieved by veneering the substructure with feldspar porcelain.

Several manufacturers introduced crown- and bridge-frameworks (Lava, 3M ESPE; Procera Forte, Nobel Biocare; Vita In-Ceram YZ, VITA; and Cercon, DENTSPLY) milled from blocks of pre-sintered yttrium-stabilized zirconium dioxide ceramic. The oversized milled frameworks are then sintered (with shrinking of the structure by 20–25%) providing an excellent fit²⁷. Other manufacturers mill fully sintered zirconium dioxide blocks (Everest, KaVo; DC-Zirkon and DC-Zirkon col., DCS Bien-Air Dental), known as HIP-ed (hot isostatic pressing) zirconia, to avoid the shrinkage factor, thus providing a superior marginal fit²⁸. However, there are several undesirable effects in milling dense sintered

ceramic blanks: possibility of unwanted surface and structural defects in the ceramic restoration that minimize overall restoration strength and reliability, longer milling time and increased wear of the milling tools²⁹.

Further improvements in the composition and chroma features, led to introduction of a new era of zirconia materials that can be used for production of all-zirconia restorations without need of veneering, thus preventing failures due to porcelain chipping³⁰. At the same time, these materials are found to have less abrasive effect to enamel of the opposite dentition compared to veneering porcelain and a pressed glass ceramic³¹ or even natural enamel³²: Lava™ Plus HT Zirconia (2012) of 3M ESPE, Zenostar® Full Contour Zirconia (2013) innovated in close cooperation between Wieland Dental and Ivoclar Vivadent, as well as Dentsply's Cercon® ht True Color (2015), zirconia discs with 16 different shades²⁶.

In collaboration with Fraunhofer Institute for Silicate Research ISC, Dentsply and VITA have used a new lithium compound to create a glass ceramic with higher flexural strength than lithium disilicate ceramic. After breaking up the partnership, Dentsply and VITA continued with their own research which resulted in the introduction of zirconia-reinforced lithium silicate ceramics - Celtra Duo and VITA Suprinity® (2013).

Humans' striving to mimic the features of the human tissues has led to the creation of a new type of dental materials, so-called 'hybrid' ceramics. In 2011, 3M ESPE have introduced the first 'resin nano ceramic', Lava™ Ultimate CAD/CAM Restorative, which consists of a ceramic particles with nano-dimensions incorporated into the resin matrix.

Taking into consideration specific structure and composition of the dentin and spongy bone that consist of inorganic and organic interconnected phases, the development of hybrid materials took another direction. The inorganic constituents of biological tissues are weak by themselves, but together with the organic matrix and specific structural distribution, materials with superior mechanical properties are built³³.

The idea for developing the novel kind of interpenetrating phase material was discussed by Dr. Norbert Thiel (VITA Zahnfabrik) and Prof. Russell Giordano (Boston University) 20 years ago. Finally, in 2013, VITA has introduced VITA Enamic®, retaining the ceramic structure of Mark II and adding a polymer. A porous feldspar glass ceramic was infiltrated with a polymer that closes the gaps between already existing ceramic material. In this way, VITA Enamic® imitates the properties of dentin, with respect to the elastic modulus and density³⁴.

These are the first attempts, ceramic materials to get features similar to the human enamel and dentin in

terms of wear characteristics and modulus of elasticity and yet to have properties as those of glass ceramics, i.e. similar optical features, flexural strength and fracture resistance in order to withstand the masticatory load⁴.

The newest one, Cerasmart™ from GC, introduced in 2014 features the highest flexural strength (in this category of hybrid materials) of 230 MPa, and in the same time offers a high flexibility (breaking energy) of 2.2 N/cm to buffer the masticatory pressure³⁵.

Conclusion

Starting from the first "jacket" crown, all the way to the newest ceramic materials, the fast and versatile technological development of the dental industry, in this field, is easily noticeable.

Glass ceramics, because of their optical characteristics, are still considered the best material when it comes to esthetics. The stabilized zirconia, as a material with astounding mechanical characteristics and strength, is used for the production of dental bridges, as a replacement for the metal substructure. Biomimetics, as a science with a very fast development rate, resulted in the innovation of the hybrid ceramics, which come closer and closer to the human tissues.

In the future, perfecting the development is expected not only for the technological processing, but for the ceramic materials as well, with maximizing their potential abilities, while minimizing their weaknesses.

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ANALYSIS OF THE DISTRIBUTION OF OCCLUSAL VERTICAL STRESS IN CANTILEVER DENTAL BRIDGES - METHOD OF FINITE ELEMENTS: A LITERATURE REVIEW

АНАЛИЗА НА ДИСТРИБУЦИЈАТА НА ОКЛУЗАЛНИТЕ ВЕРТИКАЛНИ СИЛИ КАЈ ДИСТАЛНО ПРОДОЛЖЕНИ МОСТОВНИ КОНСТРУКЦИИ–МЕТОД НА КОНЕЧНИ ЕЛЕМЕНТИ: РЕВИЈАЛЕН ТРУД

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Abstract

Cantilever dental bridges are prosthetic appliances which have abutments and distally positioned pontic. In cantilever dental bridges, occlusal forces which transfer via the distal cantilever cause changes in the dentures and teeth in terms of rotation and bending, depending on the direction and of the stress and the amount of the load. Distribution of occlusal load is an important factor for the treatment's effectiveness and its prophylactic influence on the remaining teeth. In line with this, the present paper will look at various authors who have researched the area of occlusal stress and its distribution in cantilever dental bridges. **Keywords:** Cantilever, Finite element method, Fixed partial denture, Occlusal forces, Prosthetic restoration, Shortened dental arch.

Апстракт

Дистално продолжените мостовни конструкции се протетички изработки кои имаат носачи за заби и висечки членови кои се поставени дистално од носачите. Кај дистално продолжените мостовни конструкции, оклузалните сили кои се пренесуваат преку продолжените членови предизвикуваат придвижувања на конструкцијата и забите во смисол на ротација и инклинација зависно од правецот на дејствување и јачината на силата на оптоварување. Дистрибуцијата на оклузалните сили врз забите носачи е значаен фактор за ефектот од третманот и неговото профилатичко делување врз преостанатите заби. Од тој аспект во трудот ќе биде направен преглед од автори кои се бавеле во подрачјето на оклузалните сили и нивна дистрибуција кај дистално продолжените мостовни конструкции. **Клучни зборови:** Дистален член, метод на конечни елементи, дентален мост, оклузални сили, протетичка реставрација, скратен дентален низ.

Introduction

Partial tooth loss leads to morphological, functional, and aesthetic disturbance in the functions of the masticatory system. Therapeutic means to compensate for partial tooth loss are mobile appliances, bridges, or a combination of the two. A dental bridge is a fixed prosthetic appliance used for masticatory, phonetic, aesthetic and prophylactic therapy and restoration of the masticatory system.

Planning of dental bridge appliance includes two basic elements: biological and mechanical. The biological aspect refers to the mechanism of transfer of masticatory force that is exclusively dental, regardless of whether the bridges are fixed or mobile. The mechanical aspect refers to the way bridges are connected and fixed to the abutment teeth. The pontics or the body of the bridge may be inserted between the abutment teeth (traditional bridge) or extended distally or mesially (cantilever bridge). Cantilever bridges are defined as

fixed restorations that have one or more abutments on one end, while the other end is left unsupported.

The pontics in a cantilever dental bridge may be positioned either mesially of the abutment tooth or distally of the abutment tooth. Distally cantilever dental bridges are indicated for patients with a shortened dental arch.

Aim

The purpose of this paper is to analyse the findings on the distribution of occlusal forces in distally cantilever bridges.

Material and method

The material consists of 315 papers that examine distally cantilever dental bridges. The paper looks at 38 papers where the abutments are natural teeth. The papers were acquired by means of international journals and PubMed and EBSCO database research done from January, 2005 to January, 2016. Research was done using keywords according to the Mesh index.

Discussion

The traditional goal of dental treatments is maintaining dental arches with presence of 28 teeth. According to data gathered from the first phase of the NHANES III research (Third National Health and Nutrition Examination Survey), completed in the USA from 1988-1991, the average number of teeth per capita was 23,5, while the goal set by the WHO is preserving at least 20 teeth until the age of 80.⁴

Distal cantilever dental bridges require more attention compared to conventional ones. However, if the biological and mechanical aspects of the cantilever dental bridge are well balanced, it is very likely that it is going to be successful.⁵

One of the elements that speak of the success rate of this treatment is the life span of these bridge appliances. According to Sailer, the duration of dental bridge prostheses is defined as the time frame of the experiment during which a maximum of two interventions have been made.⁶

The classifications of bilateral and unilateral partial tooth loss do not define the number of lost teeth. This is why Witter and his associates made additional classification of the distal tooth loss by distinguishing four categories of shortened dental arches: 1. Slightly shortened dental arches; 2. Moderately shortened dental arches; 3. Extremely shortened dental arches; and 4.

asymmetrical extremely shortened dental arches. According to them, decision-making on extending a shortened dental arch should be based on the principle of: examination of the masticatory system function, treatments value for the patient, oral function and the patient's perceived impact on oral health-related quality of life, as well as on the type of shortened tooth arch. Witter and his associates believe that slightly shortened dental arches should not be extended, while extending moderately shortened dental arches is indicated in exceptional cases, especially for aesthetic reasons. In the case of extremely shortened dental arches and asymmetrical shortened dental arches, they believe that there are sufficient reasons for extension.^{7,8}

Anneloes and associates made a clinical trial on patients with shortened tooth arches with 3-4 lateral teeth missing. The patients were monitored for 27,4 (\pm 7,1) years, and it was found that in 20 out of 23 participants the condition remained unchanged.⁹

The concept of shortened dental arches implies that shortened dental arches with at least 4 occluding pairs, preferably in symmetrical positions, are sufficiently capable to maintain satisfactory oral function.¹⁰

Wolfart analysed the quality of oral health via the HRQoL index in two separate groups of participants. The first group had shortened dental arches with lost molars and dental bridges that did not replace the lost molars, while the second group had shortened tooth arches and a mobile prosthesis which replaced the lost molars. The values generated with the HRQoL index did not show any significant differences between the groups. This led him to the conclusion that there is no need to replace missing molars.¹¹

According to Fueki, the concept of shortened dental arches is based on indirect evidence and it is not in contradiction with current occlusion theories. He claims that this concept is not suitable for patients aging up to 50, those with malocclusion Angle III, Kennedy class III, patients with verified parafunction and symptoms in TMJ and a significantly decreased periodontal support of remaining teeth.⁵

Aras and associates during the 1-year research examined: mastication, occlusal forces, and occlusal contact in patients with shortened dental arches Kennedy I class. The research covered three groups of 10 patients each. The first group included patients with shortened dental arch (natural teeth or bridge appliances), the second group was made up of patients with mobile partial prostheses, while the third group was a control group of patients with fully natural dentition. No significant difference was noticed between the groups with shortened dental arches with or without prostheses in the masticatory effect, however, in patients with

shortened dental arches, a significantly lower instance of contact and weaker forces were noticed compared to patients with entirely natural dental arches ($P < 0,05$).¹²

Witter monitored 74 patients with shortened dental arches and 72 with full dental arches. Following a 9-year research, Witter came to a conclusion that there was no difference between the two groups as far as the masticatory system was concerned.¹³

Two independent research studies on accepting the concept of shortened dental arches were carried out in Victoria, Australia and Great Britain. The findings were contradictory. In Victoria, Australia, 61% of the interviewees accepted the concept of a shortened dental arch, while in Great Britain, only 1.4% accepted it.^{14,15}

Prosthetic therapy is often necessary to restore the function and aesthetics in patients with advanced stage of periodontal changes. Remaining teeth are usually mobile and need to be immobilized and periodontally treated. According to the perio-prosthetic treatment first introduced in Sweden in 1970, circular fixed bridges can provide certain rigidity and a more favourable distribution of masticatory forces on all remaining teeth. This concept is in collision with Ante's rule, however, but authors justify their claim by pointing out that Ante's rule is more focused on the number of teeth. Furthermore, several multiyear research studies have shown that circular fixed bridges can be successfully supported by a minimal number of teeth if teeth are well positioned, the condition of the periodontium is under control and has kept 20-30% of the original periodontal supporting tissue.^{16,17}

Maximal force measurement of masticatory pressure is a useful indicator of the functional condition of the masticatory system. The values of this force vary depending on the measuring method, sex, and age. Still, it is of great use that the results can be compared to corresponding referential values. The masticatory force is a result of a combined action of the masticatory muscles, the biodynamics of the lower jaw and the reflex mechanisms.¹⁸

Bonakdarchian and associates found that the average maximal masticatory forces in adults with normal occlusion are significantly higher in male patients compared to female ones.¹⁹

Pain is an important factor for controlling the scale of masticatory force. Furthermore, this factor can also be used to treat some irregularities and painful conditions of the masticatory system.¹⁸

Johnsen and associates looked at the intensity of masticatory forces in each tooth separately in patients when under anesthetics and without. They noticed that the force is higher when teeth are anesthetized, i.e. when the periodontal sensitivity is off. Likewise, they noticed

that the masticatory forces are higher distally.²⁰

Fratila and associates used photoelastic analysis to look at the distribution of occlusal stress in a conventional bridge with two abutments and a pontic in between, while the other was a mesial cantilever with two units, an abutment, and a pontic. The loading was vertical on the occlusal surface. In a classical bridge, when the distal abutment was loaded, the highest strain was noticed around the connection of the distal abutment and the pontics, as well as on the distal abutment's periodontal tissue. A significantly smaller stress was distributed via the pontic to the mesial abutment. The same, only in the opposite direction, occurred when the mesial abutment was loaded. When the middle part of the pontic was loaded, an approximately symmetrical distribution of stress, however a much smaller stress was registered in the periodontal tissue of the mesial abutment. The authors explain this in relation to the number of roots, since the distal abutment has two roots, while the mesial only one. Almost identical findings on the distribution of stress in conventional bridges were reported by Motta and associates.^{21,22}

In mesial cantilever dental bridges with two units, when the abutment was loaded, most stress was distributed onto the root of the tooth. When loading was on the mesial extended unit, the greatest deforming stress occurred on the connection of the abutment and extended unit and on the apical mesial surface of the root and the mesial wall of the alveolar bone. The distal root recorded low values of distributed stress, with an occurrence of the 'pulling' phenomenon. Overall, there is strong and uneven loading of the abutment and the bone structures, and the restoration has a tendency to tilt mesially. Identical results were obtained by Eraslan and associates.^{21,23}

Planning a bridge construction must provide an optimal secure static, stability to withstand masticatory stress and to preserve the integrity of supporting tissue. Crucial to this is familiarity with the features of biological and mechanical elements of a bridge.²⁴

The stress forces generated in cantilever dental bridges are generally higher than in conventional dental bridges, due to the physical principles arising from the fact that the pontic is acting as a single lever.²⁵

To minimize the risk of a single lever effect, Jeong recommends decreasing the occlusal surface of the extension and the occlusal contacts, as well as remove contact in lateral movements.²⁶

According to Fratila, the stress loaded on partial dentures may cause: luxation, inclination, rotation and bending. This may be compensated by static and biodynamic balanced planning of construction. Cantilever dental bridges with one or more pontics have

one point of reliance and therefore can be moved in all directions, so they cannot be in dynamic equilibrium. It is therefore necessary for each bridge construction with a distally cantilever to have at least two abutments.²¹

For cantilever dental bridge constructions, Milas recommends a balanced occlusion with absolutely no interferences.²⁷

Edward lists three crucial factors in planning distally cantilever bridges: abutments, functional masticatory strain, and connection abutment and extension. The abutments need to have a periodontal surface which is larger than the tooth which is going to be replaced, the ratio of the coronary and radicular part of the abutment should be 2:3, small motility, be vital, and have a healthy periodontium. Occlusal contact should be diminished; occlusal surface of the cantileverpontic should not be in contact with its antagonists.²⁸

Eraslan analyzed on models the influence of the length of a distal cantilever of the bridge construction, the strain distribution on bridge constructions made by metal-ceramic and all-ceramic materials. The research showed that by increasing the length of the cantilever, the values of the deformation forces increase proportionally.²³

Tomás Geremia also got similar results which showed that increasing the length of the cantilever from 10 to 20 mm resulted in a rise of the axial force of approximately 50% and about 70% rise of the sagittal force.²⁹

The fact that the length of the cantilever plays an important role in the deforming strain distribution is confirmed in the research work of Bevilacqua and Rubo and associates.^{30,31}

Using the method of finite elements analysis, Maia Correia and associates looked at the deforming strain distribution on the cantilever and found that if 50N were loaded on an abutment (average value of masticatory stress), deforming strain will decrease and will reach Titanium's elasticity resistance threshold if the connector is made in oval shape with a vertical radius of 1,68 mm and a horizontal radius of 1mm.^{32,33}

Manda and associates researched the effect of increasing the vertical dimension on the maximum stress developed within the connector of the cantilever dental bridge during maximal load of a cross-arch dental bridge with a 1- and 2-unit cantilever. The researched connections were of 3, 4, and 5 mm. The increase of the vertical dimension of the distal connection to the retaining abutment, for each FDP, presented a maximum stress value decrease of approximately 25% when the height of the connection was increased from 3 to 4 mm, and 48% when the height of the connector was increased from 3 to 5 mm. For the 2-unit cantilever restoration, the stress decreases were approximately 10% for the 4-mm

connector. The highest stress value was measured on the 3-mm connector.³⁴

The design of the denture is especially significant for the distribution of masticatory stress on supporting tissues. Designing a connector located in specific conditions must satisfy biological and aesthetic needs, especially in the posterior region where the stress is much higher and clinical crowns shorter.^{23,32,35}

Romeed states that a 3-unit denture is a better solution than the 2-unit one.³⁶

Guo and associates analysed the stress distribution in the abutment periodontal ligament of posterior cantilever bridge under transient dynamic loads using a three-dimensional finite element model. A cantilever bridge was examined using second premolar and first molar and distally extended second molar. The loads were set as 250 N occlusal forces loaded at different positions on the cantilever. It was found that with the increase of loading, the stress value in the abutment periodontal ligament increased gradually. When the load was on the second molar, tensile forces appeared in the mesial part of the second premolar.³⁷

Two types of bridge constructions were researched in Korea: bridge constructions with no extensions and unilateral or bilateral distal cantilevers.

39 Korean patients were provided with 50 bridge constructions that had between 11 and 14 units with an average of 5 to 7 abutments and a total periodontal ligament area of 79% of the total ligament area of the replaced teeth, meaning abutment teeth had average 26% preserved periodont. In the 3-year follow-up examination, the bridge constructions were stable in all patients who generally maintained good oral hygiene. The change in the periodontal ligament area over the 3-year observation period was negligible (1 mm² per dental unit) and showed no statistically significant difference in relation to the three types of bridge constructions.³⁸

There are many more data in the relevant literature, however, the greatest challenge is the different methodology of research used which makes results difficult to compare. There are very few clinical trials, and the ones published mostly refer to periodical analyses.

Conclusion

Most research papers recommend that cantilevers should have at least two abutments, while the extension should have smaller occlusal surface compared to the replaced tooth and a minimal number of occlusal contacts.

Results on the masticatory stress distribution show that strongest strain occurs on the connectors of the distal cantilever and the mesial abutments.

The largest part of relevant research was performed on models, however, clinical trials with periodical patient monitoring complement them, in most cases, and help provide useful recommendations for the clinical practice.

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ASSESSMENT OF INTERNAL FIT AND MARGINAL DISCREPANCY IN FULL CERAMIC AND METAL CERAMIC DENTAL CROWNS - REVIEW ARTICLE

ПРОЦЕНА НА ВНАТРЕШНО НАЛЕГНУВАЊЕ И АРГИНАЛНА ДИСКРЕПАНЦА КАЈ ЦЕЛОСНО ЕРАМИЧКИ И МЕТАЛКЕРАМИЧКИ КОРОНКИ-РЕВИЈАЛЕН ТРУД

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Abstract

The accuracy of internal fit and marginal precision plays important role in the clinical quality and success of dental crowns. Complications caused by marginal discrepancies such as caries, gingivitis, hypersensitivity are highlighted in dental literature. Despite marginal fit, internal fit and precision have a significant role in the persistence of full ceramic and metal ceramic crowns. As the technology evolves, it's questionable which impression method and method of crown producing is giving most accurate dental crowns. Therefore, the main purpose of this study is to review previous research and data about marginal and internal fitting, different impression techniques (conventional, two-phase impression technique with polyvinyl siloxanes and digital impression using intraoral digital scanner) and manufacturing process. **Key words:** internal fit, marginal discrepancy, metal ceramic, full ceramic crowns.

Апстракт

Прецизноста на внатрешното налегнување и маргиналната прецизност на коронките се важни критериуми за клиничкиот квалитет и успех на протетските реставрации. Компликациите од маргинални дискрепанци како кариес, гингивит, хиперсензитивност се нагласени во многу студии. Во прилог на маргиналното, се вбројува и внатрешно налегнување и точност, кои имаат значајна улога во долготрајноста на целосните и металкерамичките коронки. Естетиката и отпорноста на фрактура се две главни детерминанти на денталните коронки, а третата е маргиналната точност. Затоа, како главна цел на оваа студија е да се испита внатрешната и маргинална точност на целосно керамичките и металкерамички коронки, користејќи различни техники на отпечатување: конвенционално, двофазно отпечатување со поливинил силоксани, и дигитално отпечатување со интраорален дигитален скенер. **Клучни зборови:** внатрешно налегнување, маргинална дискрепанца, металкерамички коронки, целосно керамички коронки

Introduction

Precision of internal and marginal fit plays an important role in the accuracy and success of dental crowns¹. Fixed prosthetic restorations with a poor fitting on prepared tooth are a potential danger, allowing entry and reproduction of oral bacteria that subsequently cause secondary caries and gingivitis^{2,3}. Microleakage through dental tubules may lead to pulp inflammation^{4,5}. Thus, poor internal and marginal fit of fixed prosthetic restora-

tions is the reason that reduces their resilience and longevity⁶.

For many years dental researchers examine how the crown fits. As technology developed, advances and changes also happened in measuring the fit of dental crowns: direct observation, crown sectioning, replica technique, profilometry, image analysis and 3D scanning^{7,8}. Each has advantages and disadvantages, but the visual observation is not valid because of subjectivity and tactile sensitivity of the examiner.

All procedures during the manufacturing of the crown require precision and accuracy in order to produce a restoration that fits.

There are new developments in technology that have changed impression and manufacturing: digital impression and computer-aided design / computer-aided manufacturing system (CAD / CAM).

Dental impressions are one of the key steps for successful prosthetic restoration and they can greatly affect the accuracy of the restoration. The precision of conventional impression depends on the material, type of trays and impression technique that is used.

Dental digital impression systems are growing in popularity as these high tech systems simplify the impression process, increase accuracy, decrease procedure time and enables digital integration with dental laboratories. Digital impressions eliminate patient's discomfort of using impression materials, and the 3D digital models they create are highly accurate and detailed. The scans are ready almost instantly and can be sent directly to a dental lab or to a chairside CAD/CAM system without the need to pour a model or pay for shipping. These impressions increase patient comfort, decrease clinical errors and reduce the time it takes to complete a case.

The literature demonstrates that multiple all-ceramic materials and systems are currently available for clinical use, and there is not a single universal material or system for all clinical situations. The successful application depends upon the clinician to match the materials, manufacturing techniques, and cementation or bonding procedures, with the individual clinical situation^{9,10}.

Discussion

Internal fit and marginal precision of prosthetic dentistry dental crowns

Poor marginal adaptation of ceramic crowns can damage the tooth, periodontal tissues and the restoration. Large marginal discrepancies result in dissolution of the luting agent and favor microleakage of bacteria and their bioproducts. As a consequence, the tooth becomes more susceptible to inflammation of the vital pulp (post-operative sensitivity), secondary caries and marginal discoloration. Precise adaptation is of great importance for crown longevity¹¹. In clinical practice margins of dental crown should be ideally positioned on preparation line, which is hard to achieve and to control.

Consequences that occur with poorly fitting of dental crown were topics of many authors who have found that microleakage^{12,13}, caries, hypersensitivity and gingivitis¹⁴ are common complications. A clinical research by Demir

N et al. proved that cavities are the most common cause of the failure of the crown¹¹. Factors like increased depth preparation seem to cause a bigger marginal gap. Abad-Coronel et al. claim that microleakage is the penetration of substances, such as bacteria, oral fluids, molecules, and/or ions, into a gap or a structural defect that is naturally present between restorative materials and tooth structure and damages tissues¹⁴.

Bader et al. also showed that plaque, gingival inflammation and bleeding were significantly higher in teeth with crowns than without them². Although White et al. report that marginal gap itself is not directly correlated with marginal microleakage¹, accuracy of it is estimated as one of the most important criteria for clinical quality and success of prosthetic restorations.

According to Holmes et al. "Fitting of the crown can be measured by measuring the gap between the tooth surface and the interior of the crown¹⁵". The ADA's (American Dental Association) number 8 specification suggests a maximum cement thickness of 40µm, but this range is rarely achieved. Classical study of McLean and von Fraunhofer stated that a maximum of 120µm was clinically tolerable¹⁶. With new manufacturing techniques, that discrepancy implies a greater challenge for the new materials to seal it. Nawafleh et al. stated there was no conclusive evidence about an optimum fit of contemporary systems, with a diverse range between 7,5 and 206,3µm.

Several studies have examined adapting of dental crowns and their internal fitting^{17,18}. Specifically, Carter SM. et al. informed that the force required to remove the crowns before cementation decreased with increasing layers of die-spacer. Following cementation, the mean crown elevation decreased from 547 micrometers (zero layers) to 38 micrometers (eight layers); while the mean removal force increased from 250 N (zero layers) to 375 N (eight layers)¹⁸. Olivera AB found that increasing the area of the die surface covered with spacer improved the fit of the cast restoration. Resin cement had the highest resistance to tensile forces¹⁹. Fusayama et al. proved that an interstitial layer of varnish or a thin film (thickness 40 µm) improved the fitting of dental restoration regardless of whether they were used entirely or partially²⁰.

Passon et al. confirmed that there were no statistically significant differences ($P > \text{or} = 0,05$) between the mean force required to remove the cemented copings. It appears that increasing the application of die-spacer up to 16 coats (151 micrometers) does not adversely affect the retention of cemented cast copings²¹. Results of Lee HH et al. showed that die relief reduced vertical seating discrepancy associated with cementation by up to 79 microns. Differences between paired relieved and unrelieved samples were significant ($p < 0,05$)²².

Methods for assessing the internal fitting and the marginal discrepancy of dental crowns

There are several methods that have been discussed in the literature to measure internal fitting and the marginal discrepancy. Such methods include crowns sectioning, replica technique, profilometry, image analysis and 3D scanning.

Primary, the dentist reveals marginal adaptation. Hayashi et al. studied the impact of the researcher and his visual condition in assessment of vertical and horizontal discrepancies^{23,24}. Clinical experience had the greatest impact in the identification of gaps.

Crown sectioning is an *in vitro* technique, a classic method of destructive testing as making sections of samples and then analyzing them under optical or electronic microscope²⁵. The advantage of this technique is accuracy, precision and repeatability of measurements. But the obvious limitation of this method is the destruction of the samples which creates the need for duplicates.

Radiography can also provide information regarding the marginal fitting of the crown, and again, the important thing is experience and clinical practice of the examiner. Assif et al. made a comparative study between the tactile method, radiography and replica method (using a silicone impression material) to test the marginal fitting²⁶. Their results showed that examining the thickness of the silicone layer-replica technique provides most accurate results. Researchers used different experimental set-ups and measured the marginal gaps under different conditions. Making the measurement *in vivo* or *in vitro*, before or after cementation²⁷, before or after veneering, on a chamfer or shoulder finish line, sample size and number of measurement per sample have been found to affect the marginal adaptation. Hence, differences in setting these conditions have led to inconsistencies in the results leading to conflicting conclusions concerning the clinical acceptability marginal fit of specific ceramic systems.

Mohammed M. Beyari, compared marginal and internal crown fit evaluation of CAD/CAM crowns and pressed all-ceramic crown by using stereo microscope. He found significant difference for cement thickness in midaxial, cusp, and occlusal locations within the group and no statistical difference in marginal fit of all-ceramic crowns²⁸.

Profilometry is a nondestructive method. It presents the view of both the die and the specimen in the same focal plane on monitor, thus allowing for an accurate focus²⁹. However, with profilometry the thickness of the cement layer at the marginal areas can only be indirectly inferred, and in the case of sequential analysis extreme care should be taken in repositioning the specimens, otherwise wrong results will occur.

Trifkovic et al. made a comparative study of the measuring values of the marginal gap related to the ceramic crowns made by dental CAD/CAM system using the replica technique and SEM (scanning electron microscopy). The measured values of marginal gaps of ceramic crowns using the replica technique were significantly lower compared to those measured by SEM. The results indicate that the choice of technique for measuring the accuracy of ceramic crowns influences the final results of the study³⁰. The authors concluded that the method of measurement depended on the material, and the method of analysis should be standardized.

In the impression replica technique, RT, however, the crown is filled with low viscosity light body silicone material and seated on the die simulating the cementation procedure. After setting of the silicone material, the crown is gently removed from the die, and heavy body silicon is injected inside to stabilize the thin light body film before removing it from inside the crown. The light body silicon layer can then be sectioned and measured with microscope at different sites. Researchers were using RT to measure fitting of the crowns³¹, and Boening et al. tested Procera All Ceram crowns in this way³². The main limitation of this method is distortion, even damage of the material during handling.

Necla et al. evaluated the marginal gap and absolute marginal discrepancy of Feldspathic Cerec inLab ceramic system, full ceramic crowns with two finish line designs, shoulder and chamfer, using microcomputed tomography (micro-CT). It is a computerized microtomography where more projections of the object were made from a source that rotates around it³³. The projections were transferred to a computer and analyzed with a special software.

3D method was proposed by Holst et al. for triple scan using non-contact optical scanner. Three scans were made: coping solo, master cast solo and coping placed on master cast in a final position³⁴. After digitizing the information of the area, all data were analyzed by software. Disadvantage of this method is the need to prime the translucent surfaces with contrast (full ceramic crowns). Therefore, it is rarely used because of technical difficulties.

The importance of dental impressions in internal and marginal precision of dental crowns

All the steps in the fabrication of crowns require precision and accuracy in order to produce an accurate restoration. Recent advances in technology made changes in impressions and manufacturing, in particular, digital impressions and computer-aided design / computer-aided manufacturing system (CAD/CAM). Impressi-

ons from the hard and soft tissues of the oral cavity is one of the most important steps for successful dental restoration. Over the past few decades, impression materials have changed, so today with the proper selection and manipulation great impressions can be achieved^{35,36}. In addition to impression material, its choice is of great importance. The combination of a proper material, manipulation and knowledge by the dentist gives most accurate results³⁷.

Walker et al. assessed detail reproduction of polyether and polyvinyl siloxanes, PVS, by observing the continuous replication of at least two of the three horizontal lines³⁸. Impressions were made in dry and wet conditions. They found that in dry conditions all materials provided sufficient detail reproduction at 100% of the time, but in terms of humidity, only 29% of PVS materials provided satisfactory details.

The elasticity of the material is its ability to return to its original dimension when the impression is removed from the mouth. PVS materials have the best elastic recovery of over 99%, which is demonstrated with specific section tests.

Thongthammachat et al. assessed the dimensional accuracy of dental impressions made with different types of trays and materials poured at different times³⁷. Researchers' conclusion was that the impressions made from polyether should be poured only once within one day due to instability of the material that occurs over time. The addition impression material has better dimensional stability than polyethers³⁹.

Reddy NR et al. evaluated the accuracy of dies made from dual arch impressions using different sectional dual arch trays using combinations of elastomeric impression materials. Group I was constituted of was constituted of impressions made by using monophasic impression material, Group II was constituted of impressions made by using combination of heavy body and light body, and Group III was constituted of impressions made by using combination of putty and light body. From the results obtained, dies poured from combination of heavy body and light body impressions using plastic or metal dual arch trays showed least variation in bucco-lingual dimension from master model⁴⁰. Hung et al. announced that the accuracy of addition silicones is more affected by the type of material than the impression technique⁴¹. The findings of studies suggest that impressions made with conventional trays are as accurate as those impressions made with individual trays.

Padmakar S. Patil et al. evaluated linear dimensional accuracy of polyvinyl siloxane by using custom and stock trays⁴². This study showed that custom trays provide more accurate dental casts than stock trays, but if stock trays are properly oriented, giving uniform impres-

sion thickness, they can give better result than custom trays⁴³. Among the deviations in this study all the dimensions of different impression techniques are in the range of clinical acceptability, i.e. 90µm. The conclusion of this discussion is that if accurate impression material, good impression protocol and controlled conditions that approximate clinical situation such as oral temperatures are used, a rigid stock tray may be a valid alternative to custom tray⁴⁴.

The results of Michael N. Mandikos who researched polyvinyl siloxane impression materials indicate that they produce highly accurate impressions because they reproduce fine surface detail, and have excellent elastic recovery, adequate tear strengths, and exceptional dimensional stability. They are compatible with all common die materials, can be disinfected or sterilized, and can be repoured after delayed periods. If handled appropriately, polyvinyl siloxanes can be applied in almost any indirect procedure⁴⁵.

Advantages of digital impressions is that they are accurate, saving time and cost, lab and dentist have better communication as well, comfort and acceptability to patients. Precise and comparative study with intraoral scanners is represented Logozzo et al.⁴⁶ and Skotti et al.⁴⁷

In summary, there are materials and techniques used for impressions of a soft or hard oral tissues. All past have advantages and disadvantages, but the knowledge and experience lead to proper selection and successful outcome.

Marginal and internal accuracy of dental crowns depending on the technology to be used

Many materials are used in fixed prosthetics and each has its indications, advantages and disadvantages. Fully ceramic crowns with their aesthetic properties are increasingly demanded by patients, so the biomechanical requirements and longevity should be similar to metal ceramic restorations.

Holden et al. were comparing metal ceramic crowns, leucite reinforced ceramic pressed to metal and leucite reinforced glass ceramic crown. All crowns were examined microscopically with x45 magnification. The results showed the worst marginal closing was in metal ceramic crowns, and most accurate in leucite glass ceramics pressed on metal crowns⁴⁸.

Yeo et al. examined marginal discrepancies in In-Ceram, IPS Empress II and metal ceramic crowns, using light microscopy. The results showed the smallest marginal gap in the IPS Empress II crowns, while the largest in metalcermic crowns⁴⁹.

Baig et al. compared the marginal fitting in zirconia (Cercon Y-TZP), IPS Empress II, and metal ceramic

crowns. The gap was 66,4 μm , 36,6 μm and 37,1 μm , by order. Significantly larger gap in zirconia crown he attributed to distortion in slicing the ceramic block and complicated manufacturing⁵⁰.

Syrek et al. made a comparison between full ceramic crowns made by digital impressions, and full ceramic crowns made by polyvinyl siloxanes impressions⁵¹. Crowns produced with digital impressions were more accurate than crowns produced with classic method of impressions.

Conclusion

Studies have shown that the most accurate marginal fitting have crowns made of leucite reinforced glass ceramic crown, and the largest marginal gap have metal ceramic crowns.

About the impressions, there have been some studies if modern, computerized technology can replace the standard impression techniques. Results so far have shown that digital intraoral impressions have an advantage over conventional ones, because of convenience and acceptability to patients and the absence of multiple manipulations that increases the chance of errors.

The type of preparation is contributing to the crown fitting. Preparation is standardized for this type of researching, so finish line is 1 mm wide, rounded shoulder margin with 6 degree inclination of axial walls.

In this review article are written some of the opinions, conclusions and criticisms of researchers working on issues of internal and marginal fitting of dental crowns obtained with different types of impression and different materials.

With the development of technology and new materials in restorative dentistry, studies are being made in order to indicate which are suitable for clinical use, and which are for further research.

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THE INFLUENCE OF COMPLETE DENTURES ON XEROSTOMIA AND THE CONCENTRATION OF SALIVARY PROTEINS

ВЛИЈАНИЕ НА ТОТАЛНИТЕ ПРОТЕЗИ ВРЗ КСЕРОСТОМИЈАТА И КОНЦЕНТРАЦИЈАТА НА САЛИВАРНИ ПРОТЕИНИ

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Abstract

The aim of this study is to determine the severity of xerostomia and the concentration of total proteins and albumin in the saliva of edentulous individuals, before and after wearing complete dentures. To realization of the objective, the study included 50 subjects of both sexes aged 30-70 years. The sample of the subjects was divided into two groups. The first group, the experimental group, consisted of 25 edentulous subjects. The second group, the control group, consisted of 25 subjects who have at least 20 teeth. A questionnaire was carried out among all subjects, in which questions were primarily directed to determine the medical history of the patients and to estimate the subjective feelings of the patients associated with xerostomia. The collecting of the unstimulated saliva was performed using the Spitting method and total salivary proteins were determined with Biuret test (g/l), salivary albumin was determined with modified bromocresol test (g/l). Xerostomia is much more present among patients before the insertion of the complete dentures than after the insertion. There was no significant difference between the concentration of salivary proteins and albumins before the insertion of the dentures and the biochemical composition of the saliva, after the insertion of the complete dentures. **Key words:** complete dentures, xerostomia, salivary proteins.

Апстракт

Целта на овој труд е да се утврди изразеноста на ксеростомијата како и концентрацијата на вкупните протеини и албумин во плунката кај беззаби индивидуи пред и по тоталното протезирање. За реализација на поставената цел во испитувањето беа вклучени 50 испитаници од двата пола на возраст од 30-70 години. Примерокот на испитаници беше поделен на две групи. Првата група, експерименталната, ја сочинуваа 25 беззаби испитаници. Втората група, контролната, ја сочинуваа 25 испитаници кои имаат најмалку 20 присутни заби во устата. Кај сите испитаници беше спроведен прашалник, во кој прашањата беа насочени пред се, да се утврди медицинската анамнеза на пациентите и да се проценат субјективните чувства на пациентите поврзани со ксеростомија. Колекционирањето на нестимулираната плунка беше изведено со **Spitting method (Memod со плукање)**. Вкупни саливарни протеини бра определувани со Биурет реакција (g/l) а албуминот со модифициран бромкресол тест (g/l). Ксеростомијата е многу повеќе присутна кај пациентите пред поставување на тоталната протеза отколку по нејзиното поставување. Немаше значајна разлика помеѓу концентрацијата на саливарните протеини и албум пред поставувањето на протезите и биохемискиот состав на плунката по поставувањето на тоталните протези. **Клучни зборови:** тотална протеза, ксеростомија, саливарни протеини.

Introduction

The fabrication of complete dentures among edentulous individuals, and the oral healthcare are important for the overall health, especially for the elderly. Edentulous patients who do not have dentures, or have poorly made dentures, have a greater possibility of developing an oral mucosa disease, inadequate nutrition,

respiratory, cardiac, or stomach disease. These problems are more impressive if the patient's age is more advanced.

Biological, physical and mechanical factors that improve the functional and aesthetic characteristics of complete dentures also influence the retention and stabilization of the dentures. Good retention of dentures is produced by using a valve effect, the strength of adhe-

sion, with mechanical retention which depends on the anatomical features of the jaws and proper placement of teeth. It should meet the rules of articulation and occlusal relations, to provide space for the tongue and satisfy aesthetics and phonation^{2,3}.

The problems associated with oral health among adults, which are constantly increasing in our country are becoming more serious with age. These problems include loss of teeth due to complications of periodontitis, abrasion and attrition of the teeth, the occurrence of root caries, xerostomia, taste disturbances, and difficulty in chewing and swallowing food^{4,5,6}.

Because of these problems, it is more likely for older individuals to have some sort of prosthetic appliances, usually complete or partial dentures. Celebic et al.⁷ point out that patients with complete dentures are significantly more satisfied in achieving speech function, compared with patients who have partial dentures. Complaints of patients with complete dentures are more commonly associated with avoiding various types of food, while patients who wear partial dentures mainly complain of problems with retention of the dentures. Overall, more pleasure and satisfaction of dentures is registered in patients with complete dentures than in patients with partial dentures⁸. The pain which occurs in the improperly made dentures can be the reason for developing insomnia and a disruption of the eating habits. All this leads to diminished self-esteem of the person and its reduced activity in social life^{9,10}.

The retention of dentures greatly depends on the presence of saliva in the mouth. It is defined as the ability of the denture to resist the forces which tend to separate the denture from the basis¹¹. The successful rehabilitation of edentulous patients depends on the patient satisfaction with denture retention. Two important factors associated with the retention of the denture are: adequate and intimate fitting on the oral mucosa and an adequate valve edge¹². Among other physical factors (adhesion, cohesion, surface tension, atmospheric pressure, and weight) that provide retention of the complete denture, saliva in adequate quantities and with an adequate composition is also an important physical factor that enables retention¹²⁻¹⁴.

Xerostomia prevalence increases with age and is present in 30% of those aged over 65 years. Drugs are the most common cause of xerostomia, because most of the older people take at least one medication that has a negative influence on salivary function¹⁵. Patients with xerostomia may have problems while eating, speaking, and swallowing while wearing the dentures. Denture wearers can have problems with the retention of the dentures, occurrence of traumatic ulcers and sticking the tongue on the palate. Patients also complain of halitosis, chronic burning and intolerance to spicy food¹⁶. Xerostomia is more common at night, because the secretion of saliva is

lowest during sleep. The problem increases if a habit of mouth breathing is present. Speaking and eating difficulties can disrupt the social interactions¹⁷.

Ship et al.¹⁸ and Mendoza et al.¹⁹ point out that xerostomia is relatively common in edentulous patients, which makes the wearing of complete dentures extremely problematic. Several studies point out even extreme discomfort in complete denture wearers^{18,19}.

The aim of the study

The aim of this study is to determine the severity of xerostomia and the concentration of total proteins and albumin in the saliva of edentulous individuals, before and after wearing a complete denture.

Material and methods

The study included 50 subjects from both genders aged from 30 – 70 years divided into two groups.

The first group, the experimental one, in need of complete dentures was consisted of 25 edentulous patients, admitted at the UDCC St Pantelejmon – Department for removable dentures in Skopje.

The second group, the control group, consisted of 25 subjects who had at least 20 teeth present in the mouth. These subjects were recruited at the University Dental Clinical Centre in Skopje.

A questionnaire was carried out among all subjects, in which questions were primarily directed to determine the medical history of the patients and to estimate the subjective feelings of the patients associated with xerostomia. This study excluded (either from the experimental or the control group) smokers, alcoholics, pregnant women, individuals with salivary glands surgery, individuals after radiation therapy in the head and neck area, individuals suffering from Sjögren's syndrome, diabetes, rheumatoid arthritis, or lupus erythematosus and individuals who took medications that affected the secretion of saliva.

Special questionnaires were made for determining the level of expression of xerostomia. The study used the questionnaire recommended by Carda, 2006²⁰.

Question A: Have you had a feeling of dryness in the mouth in the last 6 months? Yes/No

Question B: How much saliva is there in your mouth? A bit/Enough/ A lot

Question C: Do you have difficulty in swallowing food? Yes/No

Question D: Do you have a need to take fluids in order to make the food swallowing easier? Yes/No

The level of expression of xerostomia was determined based on the answers to these questions:

Xerostomia 1 (mild): When the answer is positive only under question A

Xerostomia 2 (moderate): When there is a positive answer under question A and another positive answer (B, C or D)

Xerostomia 3: (severe): When there is a positive answer under question A and two other (B, C or D)

For determining the total salivary proteins and albumin, from all the subjects of both the control and experimental group, we collected total unstimulated saliva under the recommendations of Navazesh²¹ for a period of 10 minutes. The subjects were advised one hour before the collection of saliva not to eat, smoke, or drink coffee, tea or to brush their teeth. The collection of saliva was performed in the same time of the day (10-11h) for all of the subjects.

The collecting of the unstimulated saliva was performed using the **Spitting method**.

The biochemical parameters in the saliva were determined in the biochemical laboratory of Surgical Clinics at the University Clinical Center “Mother Teresa” in Skopje, using a biochemical analyzer INTEGRA 400-Roche, including:

- Total salivary proteins – Biuret test (g/l)
- Albumin – modified bromocresol test (g/l)

All the tests listed were made only once for the control group, in the agreed term for the collection of the saliva.

The determining of the level of expression of xerostomia and the biochemical parameters in the saliva was

carried out, during the first examination (before taking the primary impression for dentures) and during the control examination (one month after the patient received the dentures).

Results

Table 1: Distribution of the patients according to gender

EG/sex	number.	%
Male	12	48,0
Female	13	52,0
Total	25	100,0
CG/sex		
Male	12	48,0
Female	13	52,0
Total	25	100,0

The study included 50 examinees, who were divided into two groups. The examined group (EG) consisted of edentulous patients, for whom acrylic complete dentures were made. The second group was the control group (CG), consisted of 25 examinees who had at least 20 teeth in their mouth. Both groups were identical regarding the presence of gender, and the difference registered inside the same groups (48,0% and 52,0%) was statistically insignificant for $p > 0,05$. It's a homogenous group (Table and Chart 1). The average age of patients in the experimental group was $58,4 \pm 5,6$ years and in the control group it was $58,1 \pm 9,4$ years (Table 2). The difference registered between age, between the two groups was statistically insignificant for $p > 0,05$ (Table 3).

Table 2: Average age of the subjects from both examined groups

age	number	average	minimum	maximum	Std.Dev
EG*	25	58,4	49,0	67,0	5,551877
CG**	25	58,1	35,0	69,0	9,360021

Legend: *EG – examined group, **CG – control group

Table 3: Mann-Whitney U test

	Rank Sum	Rank Sum	U	Z	p-level
age	603.5000	671.5000	278.5000	0.659697	0.509449

Table 4: Representation of the level of xerostomia in both groups and in the examined group after the insertion of the complete dentures

EG-before the insertion of dentures/xerostomia	number	%
No xerostomia	3	12.0
mild	16	64.0
moderate	6	24.0
EG-after the insertion of dentures/xerostomia		
No xerostomia	18	72.0
mild	7	28.0
CG/xerostomia		
No xerostomia	22	88.0
mild	3	12.0

The level of xerostomia is more common among the patients from the examined group (mild xerostomia - 64,0% and moderate xerostomia 24,0%) in the pre-made period of the dentures, regarding the control group (mild xerostomia -12%) and after the insertion of the dentures (mild xerostomia -28,0%) (Table 4). The percentage difference registered between the absence of xerostomia in the examined group before and after the insertion of the dentures is statistically significant for $p < 0,0001$. The percentage difference registered between the absence of xerostomia in the examined group before the insertion of dentures versus the control group is statistically significant for $p < 0,0000$.

The percentage difference registered between the absence of xerostomia in the examined group after the insertion of the dentures versus the control group, is statistically insignificant for $p = 0,1638$.

Table 5: Average value of total salivary proteins in the examined group before taking the primary impression, after insertion of the denture and in the control group

Total salivary proteins g/L	number	average	minimum	maximum	Std. Dev.
Before the insertion of dentures - EG	25	1,6	0,0	3,0	1,224745
After the insertion of dentures - EG	25	1,9	1,0	3,0	0,971253
Control group	25	1,5	0,0	4,0	0,871780

Table 6: Mann-Whitney U's test

Total salivary proteins g/L	Rank Sum	Rank Sum	U	Z	p-level
Between the EG before insertion of the dentures and the CG	645.0000	630.0000	305.0000	0.145521	0.884299
Between the EG after insertion of the dentures and the CG	574.0000	701.0000	249.0000	-1.23208	0.217920
EG before and after the insertion of dentures	590.0000	685.0000	265.0000	-0.921635	0.356719

Table 7: Average value of the albumin concentration in saliva in the examined group before taking of the primary impression, after dentures insertion and in the control group

Albumin in saliva g/L	number	average	minimum	maximum	Std. Dev.
Before dentures insertion EG	25	1,0	0,0	2,0	0.675771
After dentures insertion EG	25	1,2	0,0	2,0	0.707107
Control group	25	1,3	0,0	3,0	0.645497

Table 8: Mann-Whitney U's test

Total salivary proteins g/L	Rank Sum	Rank Sum	U	Z	p-level
Between EG before insertion and the CG	585.5000	689.5000	260.5000	-1.00895	0.313000
Between EG after insertion and the CG	626.5000	648.5000	301.5000	-0.213431	0.830991
EG before and after the insertion of dentures	579.5000	695.5000	254.5000	-1.12537	0.260435

The average value of total salivary proteins in the examined group before the denture insertion was $1,6\pm 1,2$ g/L, after the insertion was $1,9\pm 1,0$ g/L, while in the control group, it was $1,5\pm 0,9$ g/L (Table and graph 5).

According to Mann-Whitney U test, the registered difference between the average values of total salivary proteins in the examined group before and after dentures insertion, as well as in the control group, is statistically insignificant for $p > 0,05$ (Table 6).

The average value of albumins in saliva in the examined group before the denture insertion is $1,2\pm 0,7$ g/L, while in the control group it is $1,3\pm 0,6$ g/L (Table 7).

According to the Mann-Whitney U test, the registered difference between the average values of salivary albumins in the examined group before and after the insertion of the complete dentures, as well in the control group is statistically insignificant for $p > 0,05$ (Table 8).

Discussion

For many individuals the only solution for the complete loss of teeth is by fabricating complete dentures. By making the adequate dentures and with their proper maintenance and acceptance by the patient, it is expected for the main oral functions to be recovered.

The saliva has several important functions (protective, antimicrobial, digestive, reparatory, regenerative and as a buffer) by which it participates in maintaining the oral health^{22,23,24}.

The study included 50 subjects from both genders aged from 30-70 years divided into two groups. In order to get valid results, the examinees in both groups were approximately of the same age and gender. Also, as criteria for exclusion from the study, were listed all the conditions and diseases that affected the secretion of saliva and usually caused xerostomia.

Xerostomia caused by medications is an often problem, especially in the elderly patients because they take a lot of medications (antihistamines, antidepressants, antihypertensive medications, anxiolytics, diuretics etc) during the day that may have an impact on salivary glands function^{18,25,26}. The irradiation of the head and neck region, diabetes, HIV, emotional stress, diseases of the salivary glands also may contribute to the occurrence of xerostomia²⁷. The reason behind the exclusion of these diseases or conditions from the study is to determine the effect of complete dentures on salivation.

The level of xerostomia was more common among patients from the examined group. In fact, before the insertion of dentures we marked a very high level of xerostomia in about 64,0% of the patients in the exam-

ined group and 24,0% highly expressed xerostomia (moderate). Only 12% (3) of the control group examinees registered poorly expressed xerostomia (mild). One month after the insertion and wearing complete dentures, only 28% of examinees who belonged to the examined group, registered a poorly expressed xerostomia (Table 4).

The percentage difference between the registered absence of xerostomia in the examined group before the insertion of dentures versus the control group was statistically significant for $p < 0,0000$. The difference between the registered absence of xerostomia in the examined group before the insertion and one month after, is statistically significant for $p < 0,0001$. The percentage difference registered between the absence of xerostomia in the examined group after the insertion of the dentures versus the control group is statistically significant for $p = 0,1638$. That means that, patients who wear complete dentures for one month, have their subjective feeling of dryness in the mouth significantly reduced.

Xerostomia means a subjective feeling of dryness in the mouth. This symptom is often present among patients in dental practice and it is confused with the term hyposalivation. Hyposalivation is defined as a decreased secretion of saliva. Not always, the subjective feeling of dryness in the mouth is followed by decreased secretion of saliva. The results from the examination showed that most of the edentulous patients noted lower or higher level of xerostomia. It is expected that edentulous patients are followed by this symptom of dry mouth because of the lack of mechanical stimulation for the secretion of saliva. The proper and normal salivation requires certain stimulations (mechanical, chemical and physical) of the receptors in the oral cavity. Among edentulous patients mechanical stimulations are missing the most, and because of that xerostomia is more common and visible. One month after wearing dentures, patients have the subjective feeling of dryness reduced, because complete dentures compensate the lost oral functions. Also, the masticatory function is re-established, and the stimulus number on the numerous mechanoreceptors and gustative receptors is increased.

Our results are consistent with the findings of Maheshwari²⁸, while in contrast with the findings of Bekiroglu²⁹ and Michael³⁰. We assume that the differences in the results that we got were due to the differences that appeared in the examined groups. We must point out that our examinees were without systemic diseases and without any medical treatment that affects the secretion of saliva. On the other side, in Bekiroglu's²⁹ and Michael's³⁰ studies, the patients suffered from certain systemic diseases or received treatment which affected the salivary flow.

Some studies^{31,32} determine the concentration of salivary proteins in patients with complete dentures. Usually salivary proteins among these patients are correlated with the occurrence of prosthetic stomatitis. The conclusion from these studies is that patients who have prosthetic stomatitis have an increased concentration of salivary proteins.

In the saliva there are many proteins, which are mainly descended from the acinus cells but some of them, such as the albumin, derives from the blood plasma. Most of the proteins in saliva are present in very small concentrations, but are important for maintaining the health of all the oral structures. The thing that is especially important for patients with complete dentures, related to salivary proteins, is the presence of a number of proteins (histatins, PRP and immunoglobulins, etc.) which have an antifungal role. It is proved that salivary histatin 5 with his effect destroys the fungus *Candida albicans*. During our research we determined the total salivary proteins and salivary albumins. The results from our study are the following: the average value of total salivary proteins in the examined group before the dentures insertion was $1,6 \pm 1,2$ g / L, after the insertion was $1,9 \pm 1,0$ g/L, while in the control group the concentration of salivary proteins was $1,5 \pm 0,9$ g / L (Table and chart 22). The average value of albumin in the saliva in the examined group before the insertion was $1,0 \pm 0,7$ g/L, after the insertion of the denture it was $1,2 \pm 0,7$ g/L, while in the control group the result was $1,3 \pm 0,6$ g / L (Table and Chart 24).

During our study, we did not register significant changes in the concentration of total salivary proteins and albumin, before and after the dentures insertion. Also, there was not a significant difference between the concentration of total salivary proteins and albumins in the saliva of patients in the examined group and the concentration of total proteins and albumins in the control group. Our results are not in accordance with the results of Bencharit³² and Byrd³¹, who registered an increased concentration of salivary proteins among patients with total dentures. This difference that exists between our results and the results in the mentioned studies, is due to the fact that our patients wore the dentures for just a month and none of them had the manifestation of prosthetic stomatitis.

Based on the analysis of the results, we believe that complete dentures in edentulous patients have a significant influence on the salivary flow. Xerostomia is much more present among patients before than after the insertion of complete dentures. There was no significant difference between the concentration of salivary proteins and albumins before the insertion of the dentures and the biochemical composition of the saliva after the insertion of the complete dentures.

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OPTIMAL ORAL HEALTH WITHIN DIFFERENT AGE GROUPS AMONG THE POPULATION OF REPUBLIC OF MACEDONIA

ОПТИМАЛНО ОРАЛНО ЗДРАВЈЕ КАЈ РАЗЛИЧНИ ВОЗРАСНИ ГРУПИ КАЈ НАСЕЛЕНИЕТО НА ТЕРИТОРИЈА НА РЕПУБЛИКА МАКЕДОНИЈА

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Abstract

The concept of optimal oral health has been believed to meet the criteria of persisting at least twenty teeth which are functional and in undisturbed arch. Meeting such criteria may be compromised by different factors, among which age is of great importance. Therefore the aim of our study was to establish how these criteria of optimal oral health have been met in different age groups among the population of the Republic of Macedonia. The study was performed by students of dentistry during the summer semester. They were asked to talk to people in communities they live in and fill in a questionnaire. The validity of obtained data was checked by randomly picked telephone calls. The results were then separated in three groups according to age as follows: First group from 35-55 years of age, Second group from 55-65 years of age and Third group over 65 years of age. The criteria analyzed were self reported and answered how many teeth did they have left in their mouth. The results were then processed by computer program statistics 6 whereby distribution of frequencies was estimated for each group and compared among each other. The main conclusion of our results was that over 55% of the people aged from 35 to 55 years did not meet the criteria of optimal oral health. This is relatively young population and further measures and preventive programs should be undertaken in order to prevent such devastating findings. **Key words:** oral health, age related, tooth loss.

Апстракт

Оптимально орално здравје подразбира минимум на присутни заби во устата за одржување на механичкиот ефект на забите, естетиката и говорната функција. Најмалку 20 заби без болка, кои функционално се способни за цвќање и за говор и кои го задоволуваат естетскиот момент, претставуваат разумна или доволна цел на оралното здравје кај најголем дел од возрасната популација. Различните епидемиолошки испитувања укажуваат дека одредени фактори меѓу кои возраста, полот, клиничката состојба, социо-економскиот статус, културното ниво и пушењето може да влијаат на оралното здравје и на севкупниот квалитет на живот. Возраста и загубата на забите како два заемно зависни фактори имаат комплексно значење врз оралното здравје, па оттука и ја формираме целта на нашето испитување: - да согледаме колкав дел од населението од различни возрастни групи на територијата на Република Македонија го задоволуваат овој критериум на оптимално орално здравје. Испитувањето го спроведоа студенти на стоматологија во средините во кои живеат. За реализација на поставената цел беше изготвен соодветен прашалник, а воедно беа земени и контакт податоци од анкетираниите да се провери веродостојноста на добиените податоци. Прашалникот се состоеше од три групи на прашања. Првиот дел од прашалникот се однесува на социоекономскиот статус и навиките на испитаниците, вториот дел на бројот на преостанати заби и протетската згриженост додека третиот дел од истиот на причините за губиток на забите. Вкупно беа анкетирани 2367 испитаници, што во суштина претставува промил од вкупното население од различни региони на Република Македонија. Испитаниците беа поделени во три возрастни категории и тоа на лица 35-55-годишна возраст, лица 55-65 години, додека последната возрастна популација ги сочинуваше лицата над 65 години. Резултатите беа статистички обработени со компјутерската програма статистика 6 при што беше барана дистрибуција на фреквенциите за секој испитуван параметер во самата група. Од извршеното испитување можеме да заклучиме дека: - кај многу мал дел од популацијата е присутен критериумот за оптимално орално здравје, и можеме да заклучиме дека со зголемувањето на возраста се намалува бројот на испитаниците кој го задоволуваат овој критериум. Најризична група е групата навозраст помеѓу 35-55 години каде дури 50 % не го задоволуваат критериумот за оптимално орално здравје.

Introduction

“Perfect Oral Health” is defined strictly by biologic criteria that include presence of all 32 teeth which are

not involved with disease and are in ideal occlusion in a completely free of pathological changes mouth.

Setting such a high criteria for defining oral health even in the countries with highly developed public con-

sciousness about the meaning of the preservation of the oral health as well as highly developed and longtime conducted preventive programs is considered for unreal goal therefore, the concept of “Optimal Oral Health” seems a more acceptable concept.

“Optimal Oral Health” understands a minimal number of present teeth in the mouth that can provide mechanical, aesthetic and speech function.

At least 20 present teeth without pain or disease which are functionally capable for chewing and speech function and which can accomplish aesthetics are objective goal for defining the oral health in the elderly population. Of course, 20 teeth are reasonable minimum for successful mechanical function, but this number of teeth cannot guarantee patients satisfaction because chewing and speech capability are individually varying.¹

Furthermore, tooth loss reflects not only dental disease but also patients’ and dentists’ attitudes, the dentist-patient relationship, the availability and accessibility of dental services, and the prevailing philosophies of dental care.²

Different epidemiologic researches report that certain factors among which are the age, gender, clinical condition, socio-economic status, culture and also smoking can influence on the oral health and can interfere with the quality of life.^{2,3,4}

The age and tooth loss as two in-between dependent factors have complex meaning in oral health and from here we set the main goal of our research:

To find out how much of the population on the territory of the R of Macedonia from different age groups fulfill these criteria for the optimal oral health.

Materials and methods

The research was conducted with the help of students of dentistry at the state university “St. Cyril and Methodius”, in the areas where they leave. For the realization of the research an adequate questionnaire was prepared. At the same time we took telephone number for contact with the participants so that we could verify the information we have received.

The questionnaire was formed of three groups of questions: first group was related to the socio-economic status and the habits of the population, second group reflected the number of the remaining teeth and prosthetic solutions, while the third group of questions was related to the reasons for the loss of the teeth.

The research was conducted in the period of the summer semester 2010-2011.

Total of 2367 participants were questioned which in fact represents one per mile of the whole population

from different regions of the R. of Macedonia. We chose questionnaire instead of clinical examination because of the large extend of participants.

Participants were grouped in three categories according to their age:

1. 35-55 years
2. 55-65 years
3. Over 65 years.

The results were statistically processed with “Statistic 6“ program and we looked for the distribution of frequencies for every parameter we took in the group.

Results

For better presentation results were analyzed for each group separately.

First group (35-55 years of age) consists of 1543 participants. Our results show us that very small percent of the population from 35 to 55 years of age have all the teeth, only 13,8%, while 5,57% have no tooth left in the mouth (tab. 1). From the rest 78,50% in this group, with partial dentition, only 51,5% satisfied criteria for the Optimal Oral Health, 6,6% were with less than 10 teeth, while 20,9% were with less than 20 teeth (tab. 2).

Table 1. Results for tooth loss within different age groups

	33-55 years	56-65 years	Over 65 years
All present	13,00%	7,10%	4,52%
none	5,57%	10,10%	41,89%
Partial edentulisam	78,50%	72,40%	51,69%

Table 2. Distribution of frequencies for partial edentulisam within different age groups

	33-55 years	56-65 years	Over 65 years
10 teeth	6,00%	7,10%	4,52%
10-20 teeth	5,57%	10,10%	41,89%
more than 20	78,50%	72,40%	51,69%

Second group, aged 55-65, consists of 366 participants. The results in this group show us the fact that in this group there is a very small percent of individuals who have preserved all the teeth, only 7,1%, while with the increase of the age total loss of teeth is increasing too (registered in 16,1%), with 5,5% difference from the first group (tab. 1).

On the base of these results we can conclude that from the rest of 72,4% in this group, less than 50% of individuals have enough teeth to fulfill the criteria for the Optimal Oral Health (tab. 2).

Third group aged 65 years and more consists of 508 participants.

According to the results in the elderly group we found that less than 5% of the individuals had all the teeth. Results showed that in this population partial tooth loss of 51,96% and total tooth loss of 41,83% were dominating (tab. 1).

As we can see on the graphic presentation only 21,06% of individuals in this group have enough teeth to satisfy the criteria for the Optimal Oral Health (tab. 2).

Discussion

Our research concerns a problem of public health among our population emphasizing the problem of oral health related to age groups. The research was conducted in different parts of our country and included a large part of our population regardless their ethnic, religious differences.

The general idea of our study was not to prove that age was related to impaired oral health. It is well proven fact through many studies and personal experience^{4,5,6,7}. The main interest was to establish which age group was at highest risk of impaired oral health so that preventive measures or treatment plans could be prepared and implemented. The study was designed as self reported and participants among other questions and data were asked to count their remaining teeth. As the study included a huge number of participants no clinical evaluation or examination was performed, so the collected results may be even worse because participants didn't give information about the condition of their remaining teeth nor did they gave data if the teeth were in intact arch.

However the data on total tooth loss are genuine; the fact of absence of 16,1% of total tooth in the group between 55-65 years of age is far from satisfactory. Furthermore, only 7,1% of participants had all of their teeth which is a fact that brings more concern having in mind that this is a group of not that old people which have a long lifetime ahead. The general concept of optimal oral health or having at least twenty remaining teeth was established in 36,3%, or even less, regarding the facts mentioned before.

The oldest population over 65 years 5,19% had all of their teeth which wasn't so bad compared to the previous group, yet far from satisfactory but erasing concerns is the fact that only 11,1% had twenty teeth in their mouth. Such data reflect problems with impaired feeding mal-

nutrition, increased need for prosthetics treatment and financial burden on the health funds.

Given the cumulative effects of oral diseases and, in consequence, tooth loss, both the prevalence and the incidence were age dependent. Prevalence increased exponentially with age, with incidence peaking around 60 yr. Similar profiles were seen in 1990 and 2010 despite declines in prevalence and incidence estimates over time. The low use of dental services even in developed countries, the lack of financial support from government and/or third-party payment systems, and the absence of relevant oral health policies are some of the key issues that may explain elderly's poorer oral health status^{7,8,9,10}. It is possible that patients' as well as dentists' treatment preferences and expectations of dental services change around this period of life in line with social theories of aging, by which withdrawal from social roles (disengagement) and lack of social policies to protect senior adults (structured dependency) may affect their health^{11,12,13}.

The evidence presented shows how important the understanding of the epidemiology of severe tooth loss and its consequences are for treatment planning and decision making in clinical dentistry as well as for the needs of assessment and planning services in public health. The data also have implications for the content of the dental curriculum in schools around the world, as advocated by others^{14,15,16}. The data provide governments and national and international nongovernmental agencies the evidence-based data to determine priorities for research, educational curriculum development, policies, and fundings^{5,6,7}.

The main causes of tooth loss are untreated caries and periodontal diseases. Once oral disease occurs, treatment is the major approach to stop its progress, and lack of treatment is likely to lead to tooth loss.

Conclusion

The main conclusion of our results was that over 55% of the people aged from 35 to 55 years, did not meet the criteria of optimal oral health. This is relatively young population and further measures and preventive programs should be undertaken in order to prevent such devastating findings.

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